RADIO and ELECTRICAL Review

TELEVISION - COMMUNICATIONS - SERVICE - SOUND

Incorporating "RADIO and ELECTRONICS"

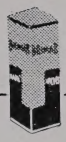
SEPTEMBER 1st, 1956

VOL. 11, NO. 7

PRICE 1/10

ON LAND

BRIMAR



IN THE AIR

BRIMAR

ON THE SEA

BRIMAR

EVEN UNDER THE SEA

BRIMAR

BRIMAR

VALVES
TELETUBES

are proving that there's no substitute for *EXPERIENCE*

Brimar techniques and Brimar experience have produced one of the world's finest ranges of replacement valves.

PERFORMANCE PROVEN IN ACTUAL CIRCUITS

on land, at sea, and in the air . . . in industry . . . in the services . . . everywhere the demands are for a guaranteed minimum life and utter reliability.

RADIO ENGINEERS

Your reputation is in safe hands when you specify Brimar Valves.

Now is the time to *BRIMARIZE!

**Remember, to Brimarize is to improvise, by utilizing Brimar equivalents.*

STANDARD TELEPHONES & CABLES PTY. LTD.

AUCKLAND BOX 571 · WELLINGTON BOX 593 · CHRISTCHURCH BOX 983 · WANGANUI BOX 293 · NEW PLYMOUTH BOX 344 · HAWERA BOX 283

Radio and Electrical Review

VOL. 11, No. 7 SEPTEMBER 1st, 1956

OUR COVER PICTURE this month shows a comparator at the G.E.C. "push-button" factory, which permits close inspection of tools and parts. See story on page 43.

Official Journal of
The New Zealand Electronics Institute (Inc.).
The New Zealand Radio and Television Manufacturers' Federation.
The New Zealand Radio and Electrical Traders' Federation.
New Zealand Radio, TV, and Electrical Traders' Association (Inc.).

Managing and Technical Director:
W. D. FOSTER, B.Sc.

Advertising Manageress:
Miss D. JAMIESON

Subscriptions:
1s. 10d. per copy; 23s. 6d. per annum, posted.
Advertising Rates supplied on application.

CORRESPONDENCE
All correspondence and contributions should be addressed to:
The Editor,
"Radio and Electrical Review",
P.O. Box 8022,
Wellington, New Zealand.

OFFICES AND LABORATORY:
Radio and Electronics (N.Z.) Ltd.,
46 Mercer Street, Wellington.
Telephone, Wellington, 70-216.
Telegrams and Cables:
"Radel", Wellington.

SOLE ADVERTISING REPRESENTATIVES for THE UNITED KINGDOM:
Cowlishaw and Lawrence (Advertising), Ltd., P.O. Box 656, 14–16 Ludgate Hill, London, E.C.4. Telephones: City 3718.
Cables: Cowlawads, London.

Contents

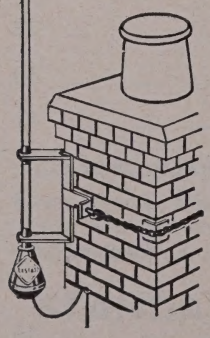
	Page
Editorial	17
The "R. & .E." Tape-Recording Amplifier—Part II	18
Television in the Service of Science	22
Will We Get Them Here?	23
New Electronic Paging System	25
For the Amateur: The Advantages of Single-Sideband	26
Philips Experimenter No. 107: A Panoramic Adapotor for Amateur Receivers—Part III	28
N.Z. Electronics Institute—Wellington Branch	30
N.Z.A.R.T. Notes	32
Notes About New Books	33
Record Talk	34
Missing and Stolen Radios	35
Commencement of Electrical and Trade Section	37
Take a Little Trouble—Win a Lot of Sales	37
New Products	38
Electrical Appliances of the Future	40
Trade Winds	41
Automation Increases Labour Force in U.S. Motor Factory	43
Television in an Age of Science, by J. E. Benson, B.Sc., M.E., M.I.E.E.	44
Around and About	46

Sole New Zealand Distributors: Gordon & Gotch (N.Z.) Ltd., Wellington

PRINTED BY HARRY H. TOMBS LTD., WINGFIELD STREET, WELLINGTON

Not if your customers have an

When you sell a radio sell an Exstat Aerial too



An "EXSTAT" Aerial is the easy and proven way to eliminate interference and give crystal clear reception. Every radio you sell will be a BETTER radio when it is installed complete with an "Exstat" Anti-interference Aerial. Point out to your customers the advantages of the "Exstat"—and enjoy increased sales and customer good-will.

VRA 301 WALL MOUNT ROD only, complete with mounting .. £4 13s. 4d.

VRA 302 CHIMNEY MOUNT ROD only, complete with mounting .. £5 13s. 0d.

ASA 301 HORIZONTAL WITH NOISE SUPPRESSION .. .. £8 12s. 0d.

ASA 412 CHIMNEY MOUNT ROD with Noise Suppression .. .. £12 17s 11d.

ASA 412N WALL MOUNT ROD with Noise Suppression .. .. £12 3s. 4d.

ASA 304 EXTRA AERIAL TRANSFORMERS .. .. £2 12s. 0d.

ASA 305 EXTRA RECEIVER TRANSFORMERS .. .. .. £2 12s. 0d.

ASA 306 MULTIPOINT TRANSFORMERS £2 15s. 6d.

NEW ZEALAND DISTRIBUTORS: **RUSSELL IMPORT CO. LTD.,** P.O. BOX 102, WELLINGTON.

BELLING and LEE LTD
ENGLAND

Components, Aerials and Filters for the Electronic and Electrical Trade

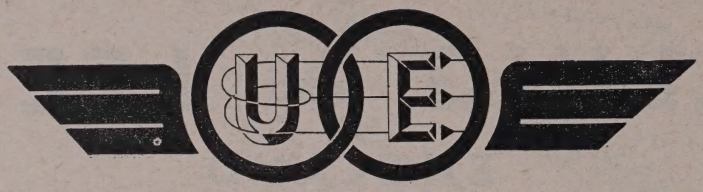
- TERMINALS
- FLEXIBLE TERMINAL BLOCKS
- COAXIAL PLUGS and SOCKETS
- MINIATURE THERMAL PROTECTION DEVICES
- FUSES and FUSEHOLDERS
- INTERFERENCE FILTERS
- HOUSEHOLD-TYPE AERIALS

The Sign of Dependable Components

FULL STOCKS AVAILABLE FROM SOLE NEW ZEALAND AGENTS:

TURNBULL and JONES LTD

AUCKLAND : HAMILTON : PALMERSTON NORTH : WELLINGTON : NELSON
CHRISTCHURCH : DUNEDIN : INVERCARGILL



THE KEY WORD FOR QUALITY
IN RADIO ENGINEERING
AND ELECTRICAL APPLIANCES
IS

Ultimate

PRECISION BUILT PRODUCTS BY
ULTIMATE EKCO (N.Z.) CO. LTD.
P.O. BOX 1166 - AUCKLAND

GRAHAM REID & CO. LTD.

Stockists of Radio Components and Electrical
Supplies for Contractors
Canterbury Agents for Enfield Cables
have recently opened at

303 DURHAM STREET CHRISTCHURCH
PHONE 88-813

Service given at all times

Write, phone, visit

GRAHAM REID & CO. LTD.
303 DURHAM STREET, CHRISTCHURCH, TELEPHONE 88-813

THE FULL RANGE OF

Garrard RECORD PLAYERS

MODEL R.C. 88
Three-speed automatic record changer for maximum of eights discs. Fitted with proved sloping spindle and adjustable platform.

Retail Price: £15 10s.

MODEL R.C. 98
Similar in design to R.C. 88 but has added advantages of electrical speed control and switch click suppressor.

Retail Price: £17 12s. 6d.

MODEL R.C. 120
Inexpensive unit with compact disc assembly for requirements of small cabinet space. Fully automatic for all three speeds. Pick-up arm takes most plug-in heads and cartridges.

Retail Price: £11 17s. 6d.

MODEL T
Three-speed single splayer with automatic stop designed for small cabinet installation. One-piece plastic pick-up arm with turnover pick-up. Stylus pressure readily adjustable.

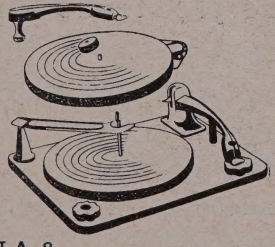
Retail Price: £9 15s.

MODEL 301 TRANSCRIPTION
Supreme in its class! A ready seller to high fidelity enthusiasts. Very fine degrees of control on all speeds. Wow and flutter reduced to absolute minimum. A triumph in engineering throughout the entire assembly.

Retail Price: £31 12s. 9d.

MONARCH Automatic and Single Players

T.U. 8



U.A. 8

MODEL U.A. 8
Four-speed Automatic Changer—the finest Monarch model yet! Now equipped with 4 speeds including the new 16 2/3 r.p.m. for "talking books". Adjustable for "manual play" and stylus pressure. Wow and rumble reduced to minimum. STOCKS DUE OCTOBER.

MODEL T.U. 8
Now you can meet the demand for a low 3-speed single player for portable or table model installations. Cream plastic assembly with shielding above motor which is suspended on rubber bushes.

Retail Price: £5 9s. 6d.

CARTRIDGES AND SAPPHIRE AND DIAMOND NEEDLES AVAILABLE

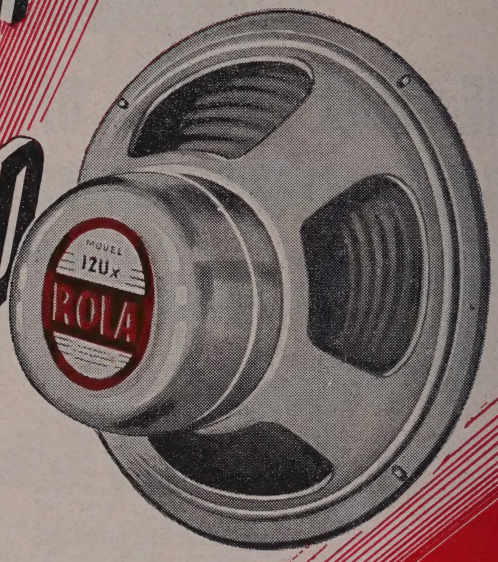
NOW! available from

TEE VEE RADIO LTD

134 Albert Street — Auckland

TRADE ONLY SUPPLIED

SPOTLIGHT ON SOUND

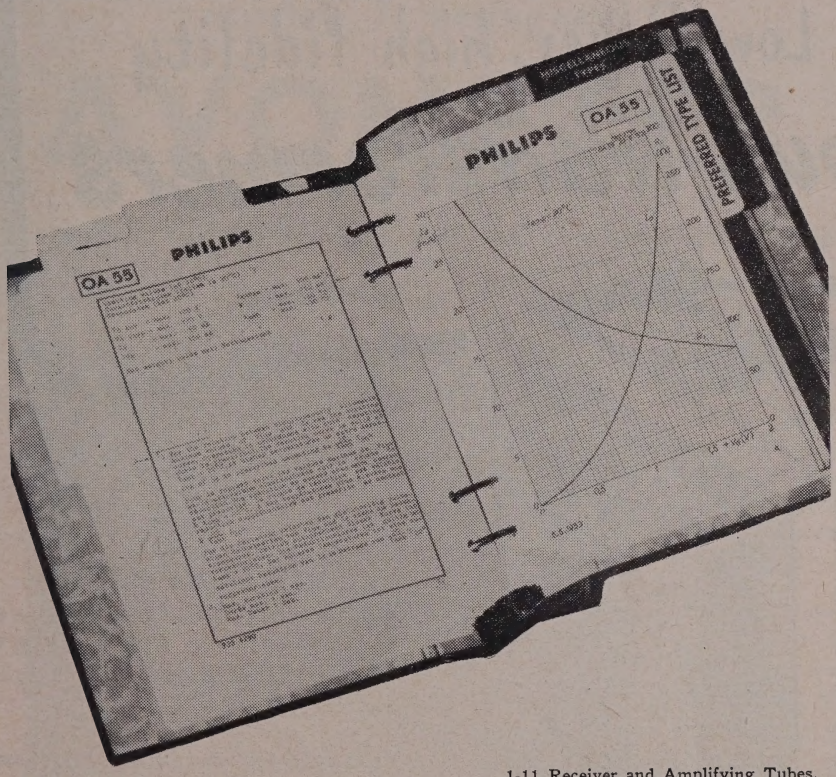


Specifications

Power Handling Capacity	12 watts (Peak)
Fundamental Diaphragm Resonance	50 c.p.s. ± 5 c.p.s.
Frequency Response	45-12,000 c.p.s.
Voice Coil Impedance at 400 c.p.s.	8.4 ohms.
Air Gap Flux Density	13,000 Gausses
Total Flux	278,000 Lines

PHILIPS TUBE DATA at your fingertips

PHILIPS Electronic Tube Handbook provides instant reference to extensive data and characteristics of all current PHILIPS TUBES



1-11 Receiver and Amplifying Tubes, Cathode-Ray Tubes, Photocells, Cold Cathode Tubes, Semi-Conductors and Miscellaneous Tubes. 111 Thyratons, Industrial Tubes Transmitting Tubes.

THE PHILIPS ELECTRONIC TUBE HANDBOOK combines in a handy and compact loose-leaf form a wealth of detailed and comprehensive tube data and characteristics:

APPLICATIONS; STATIC AND DYNAMIC DATA; BASE CONNECTIONS; DIMENSIONS; MAXIMUM RATINGS; STATIC AND DYNAMIC CHARACTERISTICS; BASE CIRCUITS, etc.

Regular Supplements Keep You Up-to-date

Approximately four times a year, supplementary loose-leaf sheets are issued covering all new and improved tubes. Naturally, the number of additional sheets issued each year will depend on the number of new types of tubes, but irrespective of quantity, supplementary leaflets are made available to subscribers at £1 per calendar year paid in advance. Only orders for supplements to the complete series of three volumes can be accepted.

The Philips Electronic Tube Handbook is printed overseas and all supplementary data on new developments is supplied immediately new or improved types are placed on the market.

THE PURPOSE OF THE LOOSE-LEAF PHILIPS ELECTRONIC TUBE HANDBOOK

Three extremely well-made prong binders which open out absolutely flat are supplied so that various groups of leaflets can be filed in the most convenient way. The binding is black leatherette with gold stamping, each cover measuring approximately $7\frac{3}{4}$ in. by $5\frac{3}{8}$ in. by 2 in. thick at the back. Each binder has a capacity of about 400 leaflets, printed both sides, making 800 pages in all. They are perforated with four holes which fit the ring mechanism, while the various tube classifications are separated by stout cardboard insets having diecut tabs for indexing. The Philips Electronic Tube Handbook is an indispensable source of reference for everyone connected with the electronics industry, radio designers, radio constructors, amateurs, and others.

Initial Subscription - £5 7s. 6d.

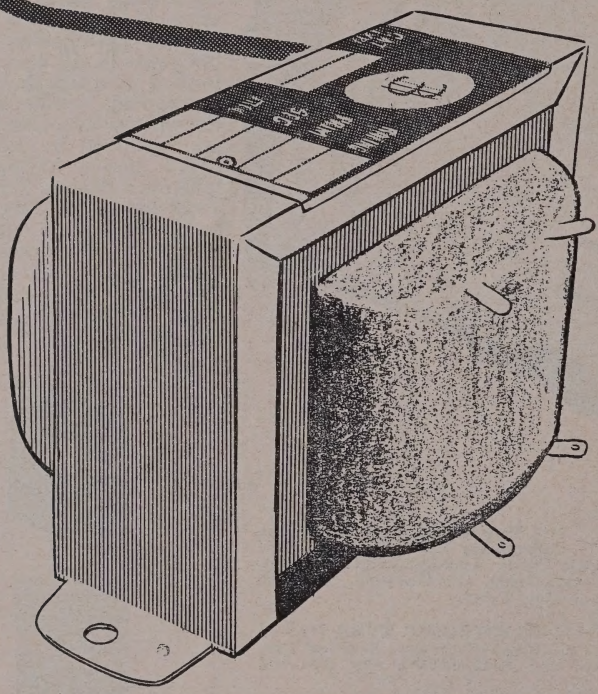
Supplements - - £1 per annum

For further information, write:

PHILIPS ELECTRICAL INDUSTRIES OF NEW ZEALAND LIMITED

P.O. BOX 2097, WELLINGTON

Low Power, high fidelity
Output Transformers



PRIMARY

Cat. No. 50S56 ..... 5,000 ohms P to P
Cat. No. 50S57 ..... 5,000 ohms P to P
Primary Inductance @ 1,000 c/s. 70 henries.

Primary Resistance ..... 350 ohms.
Leakage Inductance ..... 60 millihenries.
Frequency Response @ 5 watts input 1 db. 30 c/s. to 15 Kc/s.

Insertion Loss ..... 1 db @ 5 watts.
Core ..... $\frac{7}{8}$ in. stack Beacon No. 2.
Mounting Centres ..... $3\frac{1}{4}$ in.
Height ..... $2\frac{1}{4}$ in.
Width, including lugs ..... $3\frac{1}{2}$ in.
Depth (includes terminals) ..... $2\frac{5}{8}$ in.
Weight ..... $1\frac{3}{4}$ lb.

SECONDARY

3·7 ohms (parallel) or 15 ohms (series)
2 ohms (parallel) or 8 ohms (series)
Cat. No. 50S56 ..... 5,000 ohms P to P
Cat. No. 50S57 ..... 5,000 ohms P to P

BEACON RADIO LIMITED

CORNER BROWN AND FITZROY STREETS, PONSONBY, AUCKLAND
P.O. Box 2757 Telephones: 14-704, 13-390

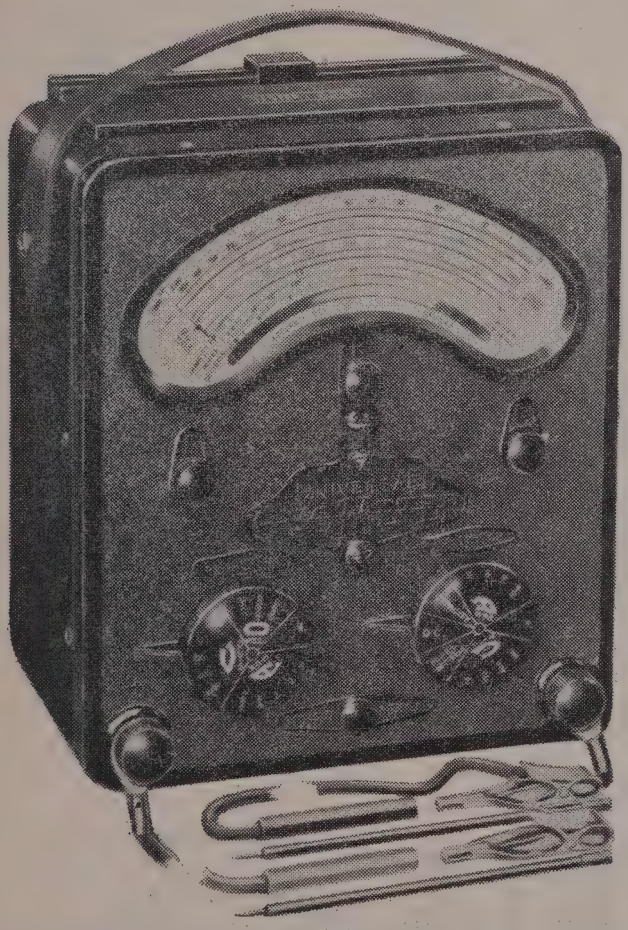
MANUFACTURERS OF ALL KINDS OF
TRANSFORMERS AND FLUORESCENT LAMP BALLASTS

BEST FOR TESTS

model 7 universal

AVOMETER

MULTI-RANGE A.C.-D.C. MEASURING INSTRUMENT



Size: 8 in. x 7¼ in. x 4½ in. Weight: 6¾ lb., including leads. Leather Case available.

The wide range and type of measurement covered, and the small power consumption make this Meter particularly suitable for radio testing, but it can also be used for general engineering. In this connection, reference to the list of Accessories for extension of the Meter range is recommended.

Fifty Ranges: 5 in. hand calibrated scale indicator. Dual A.C.-D.C. switches and press-button range for each value of current and voltage.

Total Meter resistance, 500,000 ohms,

Instrument type rectifier and internal transformer for A.C. measurements.

Three self-contained ohms ranges from 0.5 ohm to 1 megohm; higher ranges with help of Mains, with adjustment for voltage.

Automatic overload cut-out; electrically interlocked switching.

Power, Power Factor, and reactive k.V.A. can be measured on Avo-Meter with AVO Power Factor and Wattage Unit.

DETAILED SPECIFICATIONS ON REQUEST FROM THE NEW ZEALAND DISTRIBUTORS:

THE NATIONAL ELECTRICAL & ENGINEERING COMPANY LIMITED

AUCKLAND — WELLINGTON — CHRISTCHURCH — DUNEDIN — HAMILTON
WANGANUI — NEW PLYMOUTH — HASTINGS — INVERCARGILL

A Console Radiogram for £49/17/6

in a NEW Cabinet!

- Ample storage space
- 12" Rola speaker
- Monarch 3-speed automatic mixer-changer
- Light or dark oak

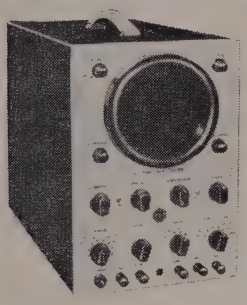
YOU WON'T FIND BETTER VALUE ANYWHERE!

they're great radios — these BELL Radios

NOW AT YOUR LOCAL DEALER

BELL RADIO-TELEVISION CORP. LTD, 274 Dominion Rd., Auckland, S.2. B.17

FULL RANGE R.C.A. TESTING EQUIPMENT NOW AVAILABLE IN NEW ZEALAND!



5 in. OSCILLOSCOPE WO-88A

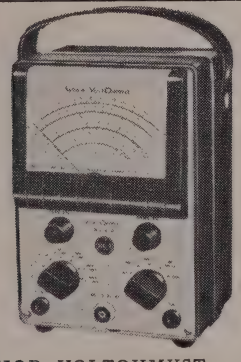
Built in voltage calibrating facilities permit simultaneous wave shape display and peak-to-peak voltage measurements. Sync polarity instantly reversible via front panel switch. Matched high impedance probe provides overall input resistance of 10 megohms and input capacitance of not less than 10 mmfd. Response is flat within —3 db from 0–500 Kc, useful to 1.0 Mc.

AUDIO SIGNAL GENERATOR WA-44A

Excellent for use in measuring impedances of amplifiers; resonant intermodulation distortion in frequency response; input and output frequency of loudspeakers; and speed of recorder/reproducer mechanisms, etc. The WA-44A features a new RC-type oscillator having wide frequency range and an amplified agc circuit ensures an output within ± 1 db over the entire frequency range.

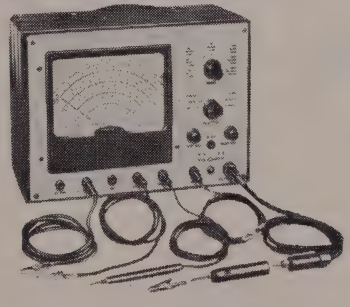
JUNIOR VOLTOHMYST WV-77A

Unquestionably the greatest value in all-electronic AC-operated vacuum-tube voltohmmeters. Features include: High-input resistance, low-input capacitance on DC functions, ability to measure DC in the presence of AC and vice versa, burn-out-proof meter circuit, ± 1% multiplier resistors, DC polarity reversing switch, negative feedback bridge circuit, etc. Plus wide frequency response and extended voltage ranges.



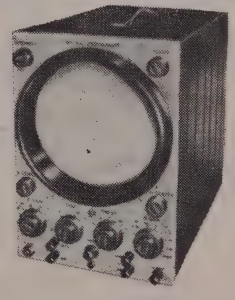
SENIOR VOLTOHMYST WV-97A

Contains full-wave signal rectifier for direct readings of peak-to-peak voltages up to 4200 volts. Measures DC voltage from 0.02 volts to 1500 volts with accuracy of ± 3% of full scale. Has 11 megohm input resistance, electronic protection against meter burn-out, zero-centre scale, rugged 200-microampere meter movement, ± 1% multiplier resistors.



MASTER VOLTOHMYST WV-87A

Featuring a 7½ in. meter, the WV-87A measures DC voltages accurately in high-impedance circuits, even with AC present. It also reads rms values of sine waves and the peak-to-peak values of complex waves or recurrent pulses, even in the presence of DC. Other features include: ± 1% multiplier and shunt resistors, a ± 2% meter movement, DC polarity reversing switch, etc. Accurate and stable enough for many laboratory applications.



7 in. OSCILLOSCOPE WO-56A

7 in. screen plus trace expansion of 3 times screen diameter provide unusually large wave-shape display for distant viewing or examination of minute portion of wave shapes. Identical frequency and phase characteristics of both the V and H amplifiers make the WO-56A invaluable for phase measurements. Frequency compensated and voltage calibrated attenuators on both amplifiers. Response is flat within —2 db from DC to 500 Kc, within —6 db at 1 Mc.

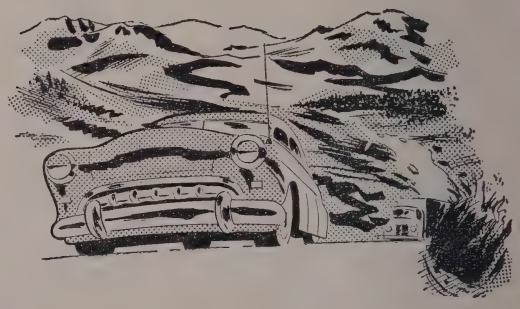
New Zealand Distributors:

AMALGAMATED WIRELESS (AUSTRALASIA) LIMITED

P.O. Box 830, Wellington —— P.O. Box 1363, Auckland —— P.O. Box 2084 Christchurch

The finest name in car radios brings you

THE FINEST CAR AERIALS



SMITHS Radiomobile

WHIP AERIALS, WITH 6FT OR 8FT MASTS

EXTEND YOUR SALES AND BOOST YOUR PROFITS BY DISPLAYING AND FITTING AERIALS WHICH WILL APPEAL TO EVERY OWNER WITH PRIDE IN HIS CAR.

AW 603 — 6ft. extended, 1½ in. telescoped ..... Retail price: 58s. 6d.

SINGLE-HOLE FIXING; 40 ADJUSTMENT FOR VERTICAL MOUNTING ON CURVED OR SLOPING SURFACES.

AW 903 — 6ft. extended, 22 in. closed .... Retail price: 47s. 3d.

AW 904 — 8ft. extended, 28 in. closed .... Retail price: 52s. 9d.

BOTH OF THESE AERIALS HAVE EASY SINGLE-HOLE FIXING AND UNIVERSAL MOUNTING FOR WING OR FENDER.

AR 32 S — 39 in. extended — friction ball joint — Universal roof mounting .... Retail price: 46s. 6d.

AR 27 S — 39 in. extended — three-position parking from inside car — spring-loaded — Universal roof mounting ... Retail price: 58s.

ALL AERIALS ARE COMPLETELY WATERPROOFED AND MADE OF HARD-DRAWN BRASS, FINISHED IN NICKEL CHROME TO GIVE LASTING WEATHER PROTECTION AND SMART APPEARANCE.

Inquiries to:

HIS MASTER'S VOICE (N.Z.) LTD.

P.O. BOX 296, WELLINGTON

HIS MASTER'S VOICE

EDITOR

PORTABLE TAPE RECORDERS

For home and business recording

Rich in fidelity, range, and tone qualities.

Three hours full playing time.

Ideal for use with pre-recorded tapes.

Complete with crystal microphone and 1800 ft. spool L.P. Tape

RETAIL ONLY
78 GUINEAS

TRADE INQUIRIES DIRECT TO NEW ZEALAND DISTRIBUTORS

THE C. & A. ODLIN TIMBER & HARDWARE COMPANY LIMITED

CABLE STREET ——— WELLINGTON

or the undermentioned wholesalers:

AUCKLAND: Messrs Waldo Hunter Ltd., 401 Victoria Arcade, Queen and Shortland Streets.
CHRISTCHURCH: The Gordon Electrical Co. Ltd., 192 Madras Street;
DUNEDIN: Messrs R. H. Gardner & Co. Ltd., 111 Moray Place.

SUBSCRIPTION ORDER FORM

Subscription Department,
Radio and Electronics N.Z. Ltd.,
P.O. Box 8022, Wellington, N.Z.

Please send "Radio and Electrical Review' every month for one year, and thereafter till countermanded, to the following address, and accept remittance of ..... enclosed.

Annual Subscription Rates:
New Zealand, £1 3s. 6d., post free.
All other countries £1 4s., post free.

Name of subscriber .....

Address .....

.....

Date Subs to commence

EICOnomise — Buy EICO INSTRUMENT KITSETS

GOING PLACES?
RIDE BY RAIL AND RELAX!

ENJOY THE LOW-PRICED COMFORT OF RAILWAY TRAVEL SERVICES . . .

RELAX IN ROOMY, FOAM-RUBBER SEATS . . . OR SLUMBER PEACEFULLY, RESTFULLY IN LUXURIOUS SLEEPING CARS.

EXPRESS TRAINS AND RAILCARS ON REGULAR, FAST, CONVENIENT SCHEDULES CAN TAKE CARE OF 10,000 PASSENGERS A DAY ON MAIN ROUTES LINKING PRACTICALLY ALL NEW ZEALAND TOWNS AND CITIES.

Ask at any railway booking office or Government Tourist Bureau for information

Go by Train or Railcar!

NEW ZEALAND RAILWAYS

EICO INSTRUMENT KITSETS

Only EICO have 1200 DISTRIBUTORS in the U.S.A. "Covering Coast to Coast".

221K 4½ in. Meter V.T.V.M. - - - - £21
AC/DC Volts: 0–5, 10, 100, 500, 1000
And 30Kv with H.V.P. Probe.
And 250 mc/c with R.F. Probe.
And Peak V with P.T.P. Probe.
Ohms: .2 ohms to 1000 megs.
Db: —20 to + 55.

Input R 25 megohms. 1% Precision Multipliers. Stable accurate double triode Bridge circuit. Three-colour, deep-etched RUB-PROOF Panel.

324K. R.F. Signal Generator - - £21 3s. 6d.
150 Kc/s to 145 Megacycles in 6 fundamental Bands; one harmonic band to 435 mc/s. ± 1.5%; Frequency accuracy; 6 : 1 Vernier tuning knob; Variable depth internal modulation 400 c.p.s.; Turret-mounted slug tuned coils for max. accuracy; Fine and Coarse attenuators.

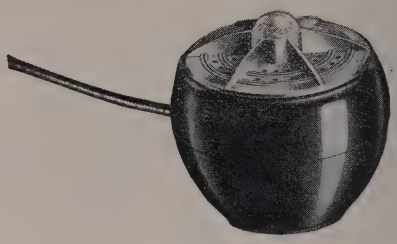
JOHN GILBERT & Co. Ltd.

TASMAN BUILDINGS — ANZAC AVENUE
AUCKLAND.

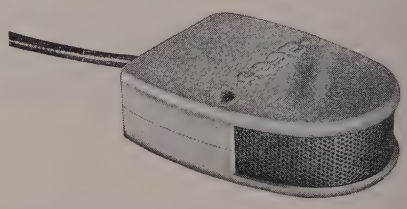
THE SPECS ARE THE PROOF ———
——— FOR BEST BUYS, BUY EICO

acos

Crystal Microphones



Retail Price 77/6
Acos Type MIC 33-1
Designed for high-quality public address and home recording fields.



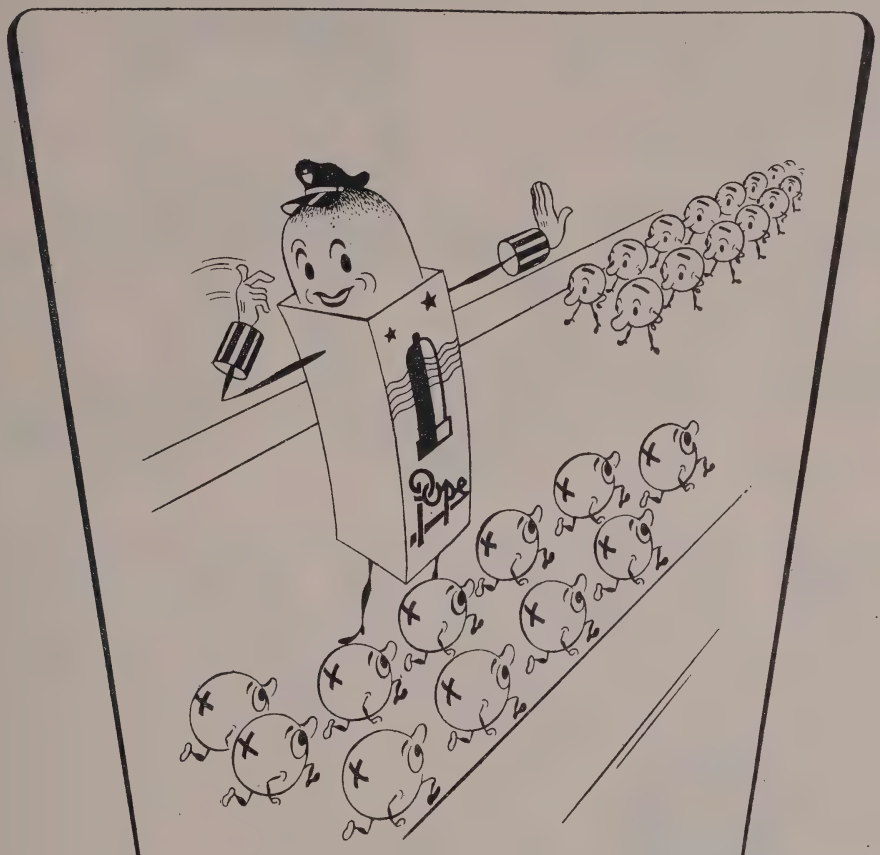
Retail Price 42/6.
Acos Type MIC 35-1
General purpose microphone with high sensitivity and substantially flat characteristic.

Acos Type MIC 36 Series High Sensitivity with omnidirectional pickup field. Attractive contemporary design. Alternative models with or without switch and suitable adaptor for floor or table stands

Retail Price 87/6.

Manufactured by
COSMOCORD LTD.
Enfield, Middlesex, England.

Sole New Zealand Representative:
DAVID J. REID (N.Z.) LTD.
P.O. Box 2630, 271 Victoria St. West, Auckland.
Phones 30-832 and 72-247



Pope rectifying tubes meet your most stringent requirements.

Pope RADIO TUBES

NEW ZEALAND DISTRIBUTORS:

RUSSELL IMPORT CO. LTD.

WELLINGTON: 20 Bond Street, P.O. Box 102, 'Phone 43-436.
AUCKLAND: St. Mark's Road, Newmarket, P.O. Box 9038, 'Phone 24-078.
CHRISTCHURCH: Y.M.C.A. Building, Cnr. Cambridge Terrace and Hereford Street, P.O. Box 1871, 'Phone 62-705.

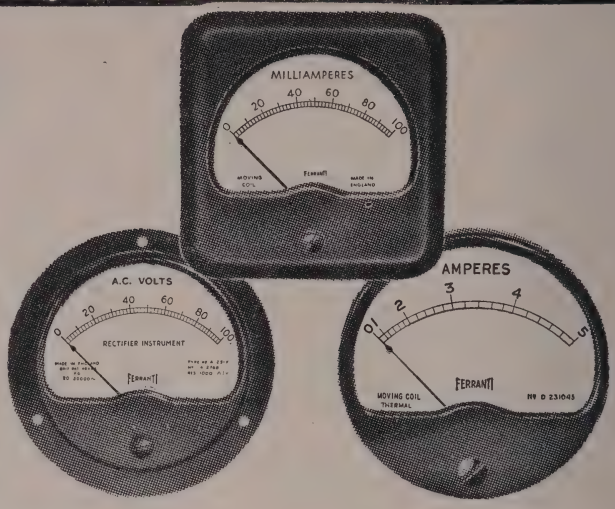
FERRANTI
INSTRUMENTS

AVAILABLE FROM STOCK

A full range of famous Ferranti instruments of flush fitting type is available from stock whilst projecting and portable types and square flush fitting are available at short delivery ex works.

Two-inch instruments made to British Inter-Service specifications and American 2½ in. specifications, are also available The 2½ in. is interchangeable with the 3½ in. American instrument to A.S.A. specifications.

Also available: 3¼ in. round and 3½ in. rectangular, and 4 in. and 6 in. round or square.



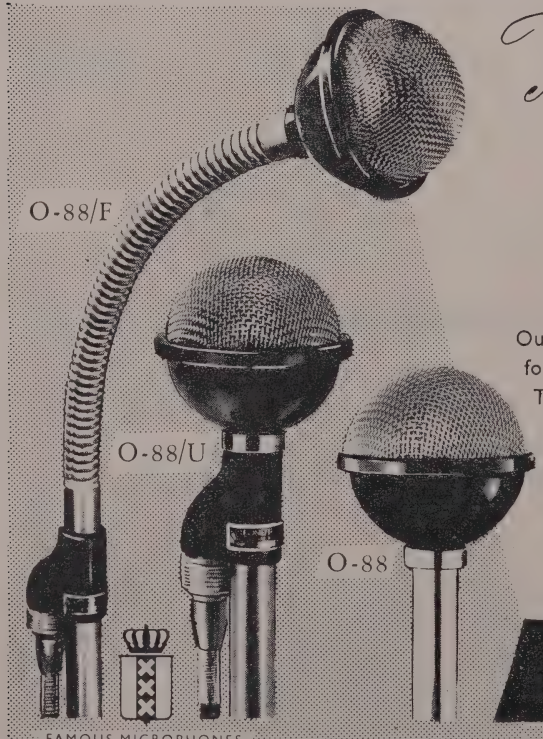
For further particulars get in touch with the Sole New Zealand Agents:

ARTHUR D. RILEY & CO. LTD.

68 THE TERRACE, WELLINGTON
and Hobson Street, Auckland.

South Island Representative:
R. REDPATH, 256 St. Asaph Street, Christchurch.

F FERRANTI



Three popular microphones by **Ronette**

series O-88

Our O-88 series has been especially developed for use with magnetic recording equipment. These microphones are equally sensitive to sound reaching it from all directions. They are obtainable with different voltage/frequency response curves, to suit your special requirements.

Ask for leaflet Nr. 508 describing our patented cartridges.

GREEN & COOPER LTD.
43 LOWER TARANAKI STREET, WELLINGTON
Phone 54-418. Telegrams: "Fidelatone"

R.N.Z.A.F. RADAR REUNION IN WELLINGTON

One branch of the armed services in World War II which has not so far held a reunion is the technical signals branch of the R.N.Z.A.F. Those of the war-time signals and radar fraternity resident in Wellington have been fortunate enough to maintain contact with one another without difficulty, as a large proportion of them are still occupied in the radio industry, or in Government departments having an active peace-time interest in communications and radar. Some, of course, are still on the permanent staff of the R.N.Z.A.F. For some time now, it has been felt that the time is ripe for a Tech./Sigs. reunion to be held, more particularly for the very large number of war-time signals and radar "bods" who have not been able to maintain contact with many of their war-time associates.

Accordingly, a strong committee was set up in Wellington a short time ago to organize such a reunion. It is to be held on 17th and 18th of November, 1956, in Welington, and sub-committees have been formed to look after such important matters as accommodation, catering, entertainment, etcetera. Letters have been written to a number of men whose addresses are known to the committee, but there must be hundreds who might wish to attend, but whose addresses are not known. Those reading this announcement who are themselves interested in attending the reunion, or who know of others who might be, are urged to write for further particulars to the Secretary, R.N.Z.A.F. Tech. Sigs. Reunion, P.O. Box 8022, Wellington. Those attending can be assured of an excellent weekend, and of meeting again many of those with whom they served during the war.

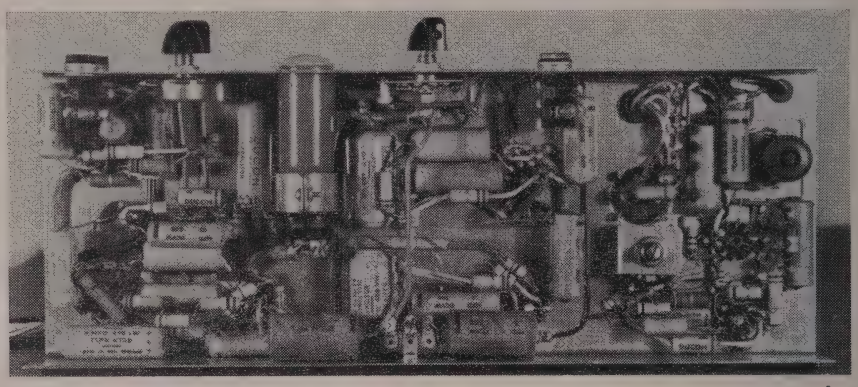
NEW ZEALAND CERTIFICATES IN ENGINEERING

Elsewhere in this issue is a brief report of a talk given by Dr. B. C. Lee, to the Wellington branch of the New Zealand Electronics Institute (Inc.) on the subject of the recently-instituted New Zealand Certificates in Engineering. At present, there must be many who have not heard of these certificates. They are intended to act as a qualification in engineering subjects for those who are not able, for one reason or another, to take a university degree in engineering, but who are capable of work requiring a much higher standard of engineering education than is obtained by the technician. It appears, from what Dr. Lee had to say, that there is a considerable need in this country for persons qualified according to this scheme. There is, of course, a shortage of engineers, too, and this is accentuated by the fact that the intermediate grade of engineer-technician does not exist. What happens is that engineers, whose training fits them to undertake design work requiring the highest standard of engineering knowledge, have to do much detailed work themselves, that should rightfully be delegated to someone whose broad knowledge of engineering subjects is not so extensive as the engineers', but who nevertheless has had the same kind of basic training as an engineer, though not to so high a standard. It is only when such men are trained and able to take up active work, that the engineers we do have at present will be able to use their abilities in the most profitable manner.

One of the options for the Certificate in Engineering follows the line of communications and radio engineering, and it is naturally in this branch of the syllabus that this journal is most interested. It has always seemed to us that a great gap existed in the list of opportunities available for young people who want to take up radio as their life's work. On the one hand there is the university, with its six-year course for B.E. (Electrical), at the end of which the student may do post-graduate work in electronics, and on the other, there is the possibility of apprenticeship in the radio trade, and the earning of a radio serviceman's certificate. These two avenues represent the highest and lowest levels of attainment in the field, and so far as their demands on the capacity of the students are concerned, they are literally poles apart. Many excellent young people, just out of school, fall in between. One would hesitate to recommend to them that they should study for nothing more advanced than the serviceman's Trade Certificate, and yet they may not be able to tackle a university degree course. The "middle group" engineer should be encouraged, because there is a definite place for him in industry and research, and it appears as if the Certificates in Engineering will provide him with a very suitable course to follow. Indications already are that the Certificates will gain official recognition from Government departments which employ engineering personnel, and once this happens, it will not be long before industry recognises them as very worth-while qualifications. It is to be hoped that this latest addition to our system of technical education meets with such recognition at the earliest possible date, and that many young people will be persuaded to undertake the excellent courses of instruction that have been prepared for those wishing to qualify in this way.

The "R. & E." TAPE-RECORDING AMPLIFIER—Part II

In the August issue of this journal, Part 1 of this article described the complete set-up of the seven-valve recording and reproducing system, and a start was made with the detailed description of the circuits themselves. Part 2 below, continues with the recording amplifier, whose circuit appears in this instalment.



Under-chassis view of the record/playback system.

THE RECORDING AMPLIFIER

As has been described elsewhere in considerable detail, it is necessary to feed a tape recording head not with constant voltage at all frequencies, but with constant current. The simple and fundamental reason for this is merely that the effect we are trying to produce is one whereby we get constant magnetizing force at all frequencies, and this in turn requires that the current in the head's winding, and not the voltage across it, should be the same at all frequencies.

This requirement poses an immediate difficulty, for all the valve circuits to which we are accustomed provide constant output **voltage** with varying frequency, and indeed this is what we mean when we say that an amplifier has a flat frequency response. The astute reader will by this time have realized that if the head were purely resistive or, put another way, possessed neither inductance nor capacity, there would be no problem at all, for if a resistor is fed with a voltage which is constant with frequency, the current also will be constant; this is no more than a simple application of Ohm's Law. In practice, however, the head possesses both inductance and resistance, not to mention some unavoidable capacity, so that a simple application of Ohm's Law no longer fills the bill. Fortunately, except at frequencies above the audio range, the capacity can conveniently be forgotten, so that we are left with a device which amounts to a circuit containing a large inductance, in series with a relatively small resistance. At high frequencies, the inductance predominates, and the head behaves as if it were a pure inductance. Its impedance is thus directly proportional to frequency, and if it is fed with constant voltage, the current will not be constant, but will be inversely proportional to frequency. In order to achieve constant-current recording, we must resort to one of a number of possible stratagems. One is to use an amplifier whose frequency response is not flat, but rises so as to make the output voltage directly proportional to frequency, then since the impedance of the head is also directly proportional to frequency, the current through the head is constant with frequency.

A second, more commonly used trick, is to use a normal "flat" amplifier, and to feed the head from it through a large series resistance. This resistance is made much higher in value than the highest impedance the head reaches at audio frequencies. In this way, the series resistor swamps the impedance of the head, and that of the combination is made almost equal to the value of the resistor, irrespective of frequency. Such an arrangement will obviously give constant current through the combination of resistor and head in series, and thus in the head itself.

A third method is to build an amplifier with a flat frequency response, but with a very high internal resistance. Such an amplifier is an ordinary pentode amplifier valve, which can be capacity-coupled to the head. This scheme is fundamentally the same as the previous one, the only difference being that in the third method, the swamping resistance is built in, as it were, to the amplifier valve, instead of being connected externally, as in the second method.

The method used here is the third one. A pentode recording amplifier is not used, however, but instead a triode output valve is used in such a way that its effective output impedance is very high. The advantage of this method is that the effective output impedance can be made very much higher than that of an actual pentode valve. In addition, the amplifier is one using a high degree of negative feedback, and consequently has very low distortion. This provides a much better signal than the more common method, which is the second of those described above, and represents **a considerable improvement on the recording amplifier described in our previous series of articles on tape recording circuits.**

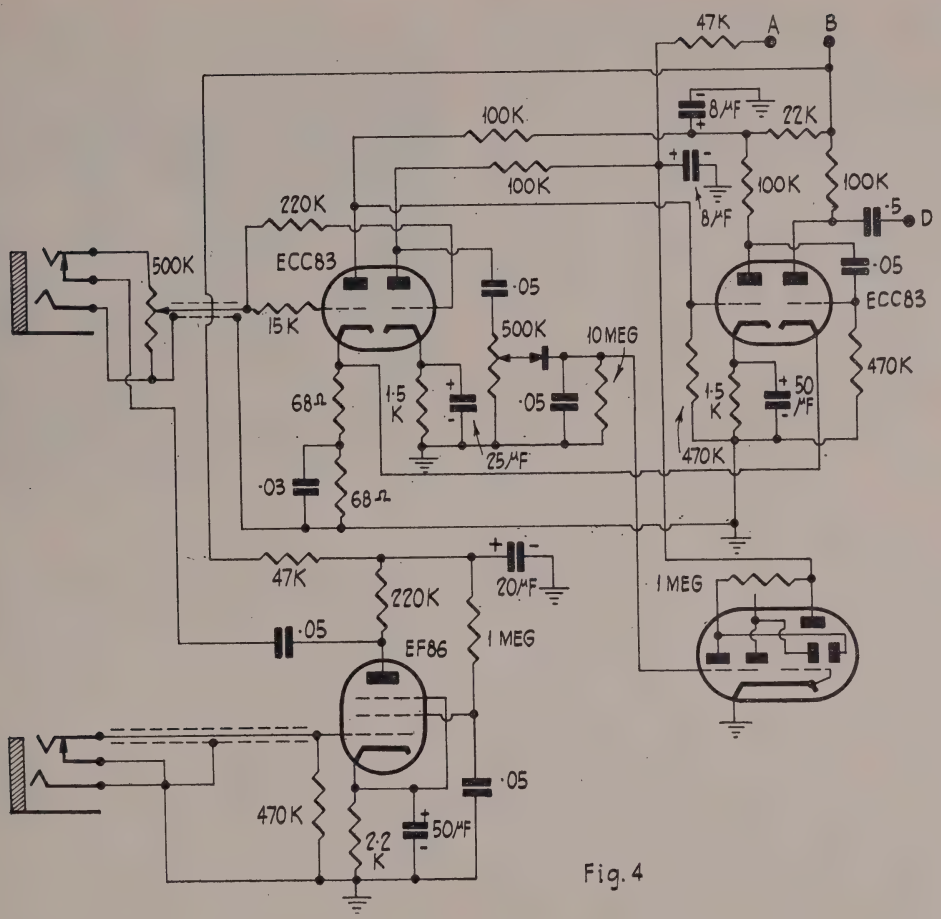


Fig. 4

The system is shown in full in the circuit diagram, Fig. 4.

The amplifier is a three-stage resistance-capacity-coupled one employing high-mu triodes which are ECC83s or 12AX7s. Each stage has a mid-frequency amplification of some 57 times, which in the case of the first and last stages is reduced slightly by the negative feedback caused by leaving the cathode resistor unbypassed. The overall gain without feedback would be in the region of 91,000 times, if the main feedback were disconnected. It is not actually possible to do this, because the feedback connection is made by using a common cathode resistor for the first and last stages. With the feedback connected, the overall amplification is reduced to approximately 135 times, if the load resistor is assumed to be the plate resistor of the last valve. In actual practice, the load is the head, which is connected through a blocking condenser from the plate of the output valve to earth. This has the effect of reducing the amplification considerably, and also of making it proportional to frequency; the main point about the amplifier is that the negative feedback is not voltage feedback, as is usually the case, but current feedback. This means that the **current** in the output valve is made to become a close replica of the **voltage** at the input. Current feedback has the property of increasing the apparent output impedance of the amplifier, and in this case, the effective output impedance is several megohms, so that the head must be fed in constant-current fashion.

It might be thought that a three-stage amplifier with so much negative feedback would be subject to instability, but such is not the case at all. No difficulty was experienced with the original, which was perfectly stable with or without the head connected, and which exhibited its constant-current properties perfectly.

The apparent complication of the circuit diagram is due mostly to drawing difficulties, because two of the triodes are contained in one envelope, as the sections of an ECC83. The third triode is one section of a further ECC83, which leaves one section to spare. This is used in the level-indicator circuit, which is also on this diagram. The level indicator consists of an EM34 magic eye tube, whose control grid is fed with rectified and smoothed audio signal, from a crystal diode. This is in turn fed from the second section of the first ECC83, which gets its signal voltage directly from the input to the main recording amplifier, through a 220k. isolating resistor. This is the only suitable point at which the audio pick-off for the level indicator can be made, because

such a pick-off must come after the volume control, but before the main amplifier, in order that the frequency response of the signal that actuates the indicator shall be flat.

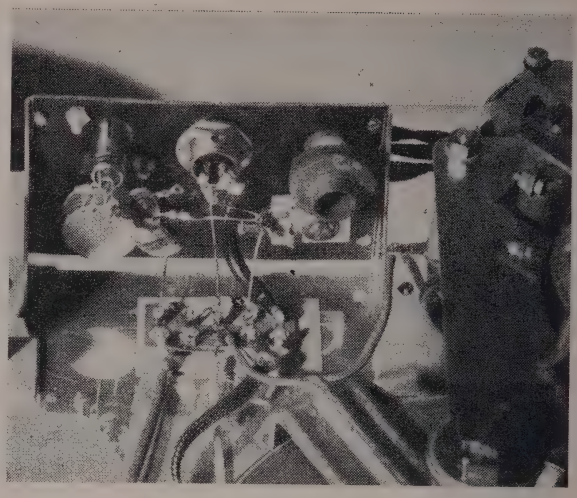
The EF86 is a high-gain pre-amplifier for use with a low-level microphone. Its output is connected through the closed contacts on the high-level input jack to the volume control, so that the through connection is made automatically as long as there is no plug inserted in the jack. When one is plugged in, however, the through connection is broken. A closed circuit jack is also used at the input to the EF86, and the closed contact of this one is arranged to short the grid of the tube to ground when nothing is in the jack, thus preventing hum pick-up at the grid.

The EM34 magic eye tube has only one of its triode plates connected, the one left without a feed resistor being that which gives the less sensitive deflection. In this way only the sensitive shadow operates, and the 500k. level-setting control following the magic-eye amplifier valve can then be set so that the eye just closes when the maximum allowable signal for full modulation of the tape is fed to the head. Thereafter, the pre-set level control remains untouched, and the eye is used as an indication of the recorded level. Note also that the magic eye and its amplifier valve obtain their H.T. voltage from the point A, while the remaining valves in the recording amplifier get it from point B. Reference to the switching diagram will show that the H.T. line A is switched on only during recording, and feeds the H.F. oscillator as well as the circuits mentioned in the record amplifier. In this way the magic eye H.T. is removed at the same time as that of the oscillator. This allows the eye to act as a warning light, indicating that the switch is in the Record position, and therefore that the erase head is energised. This helps to avert the disastrous result of starting the tape moving with the erase circuit operating unintentionally. Pre-recorded tapes are very expensive, and tapes one has made oneself are often irreplaceable, so that any precautions that will prevent or eliminate accidental erasure are well worth while.

There is a very good reason for leaving the record amplifier working, so that the H.T. does not have to be switched off. Should the switch section which changes the head from the output of the record amplifier to the input of the playback amplifier operate a fraction of a second after one which switches the H.T. off the record amplifier it is possible for a switching thump to be applied to the head. Such a thump often takes the form of a uni-directional pulse, which can quite easily cause the head to become magnetised. If this happens, there is almost certain to be a large increase in the noise level during playback. The possibility is to all intents and purposes eliminated by leaving the H.T. on the record amplifier at all times. The output blocking condenser is then always charged to its normal voltage, and this means that the end nearest the head will be at earth potential, so that re-connecting the head when switching back to record, will not cause a D.C. pulse to be sent through the head either.

THE PLAYBACK CIRCUIT

This was printed on page 26 in last month's issue, and is identical with the circuit shown in the previous series of articles. The first EF86 is a pre-amplifier, with a conventional flat frequency response,



View of the small paxolin panel mounted under the deck, and holding the components shown in Fig. 1, the head-wiring diagram. On the left are L_3 and the tuning condenser, while at the right is seen the bias adjusting potentiometer. In the front are the two sockets into which the three co-axial leads from the chassis are plugged. The one for the R/P head is of the three-contact variety.

whose job is to provide amplification at all frequencies prior to equalization for the non-flat response of the tape when recorded, as it should be, with constant current at all frequencies. The output from the playback head is very small—only about 2 millivolts at 1000c/sec. This in itself requires the playback amplifier to be extremely free from hum and noise if a good signal-to-noise ratio is to be obtained. In fact, the situation is rather more difficult than the above figure would indicate, because the output at low frequencies (i.e., below about 1000c/sec.) is proportional to frequency, falling at a rate of 6db. per octave. Thus, at 100c/sec., the output will be only 0.2 millivolts, or 200 microvolts, if it is 2 millivolts at 1000c/sec. The low-frequency response is wanted to extend to, say 40c/sec., so that the signal voltage will be only about 100 microvolts at the maximum recording level, at 50c/sec.; if therefore a signal-to-hum ratio of only 40db. is aimed at, the equivalent hum voltage at the grid of the first tube in the playback amplifier must be no greater than 1 microvolt! Now with a low-frequency response that falls regularly, an amplifier used for tape playback must have the opposite frequency characteristic. That is to say, the response must be a maximum at the lowest useful frequency, falling thereafter in a linear manner until about 1000c/sec. is reached, after which the response is required to flatten out, and stay flat up to high frequencies. Thus, the playback amplifier has the greatest gain at low frequencies, and this adds to the difficulty of obtaining a level overall response down to, say 40c/sec., without at the same time running into difficulties with hum. This explains why many commercial tape recorders built for sale to the public rather than for professional or high-fidelity applications, have their response cut quite sharply at 70

c/sec. or thereabouts. Doing so avoids a great deal of the hum difficulty mentioned above.

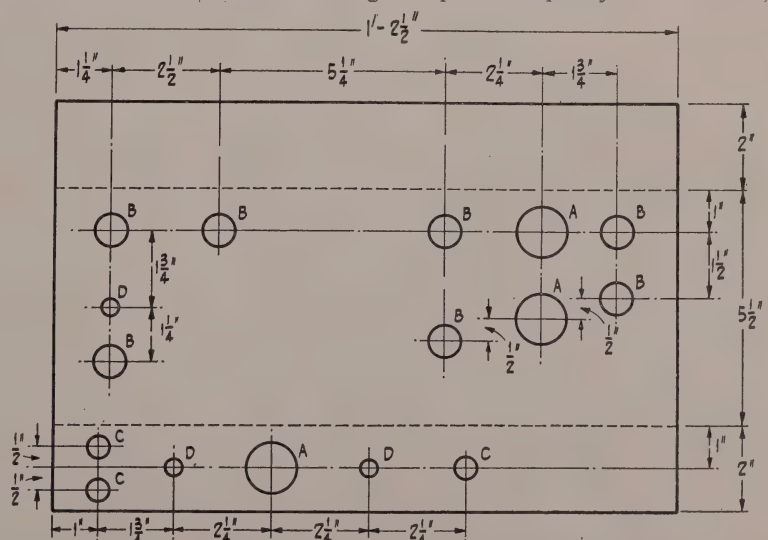
There are several sources of hum in a tape playback amplifier. Perhaps the most important is in the tape deck itself. It contains up to three A.C. motors, and unless these are specially built for the job, they are likely to have quite strong external 50 cycle fields. The playback head is therefore situated in a hum field of measurable strength, and there is a considerable problem in preventing the head from picking up hum. One method of prevention is to enclose the head as completely as possible in a heavy magnetic screen. Sometimes this is made of thick cast iron, and sometimes it is of thin mu-metal. However, the use of a magnetic screen does not give complete protection, for several reasons. In the first place, there must be a gap in the shield to enable the tape to be threaded in front of the heads. This is sometimes tackled by backing the pressure pads with a small piece of mu-metal so that the gap is almost closed during playback. Secondly, the hum field may be so great as to saturate a thin mu-metal shield, so that its shielding effect is greatly reduced, or even completely eliminated. This seldom happens in commercial decks, but can easily do so in home-built ones. The cure in this case is to use a large, thick, shield of cast iron, with the mu-metal shield inside it. The latter is then allowed to become completely effective.

Another method of combating hum which is always used, is found in the way in which the heads are made. The laminations of the core are nearly always circular in shape, and there is a second gap in the core, diametrically opposite the active gap. The winding is then put on in two halves, one on each side of the line joining the gaps. The coils are connected in series in such a way that the output voltages add when the input comes only from the active gap. If the whole head is situated in a magnetic field, such as a hum field, the voltages induced in the windings by the two gaps are equal and opposite, and cancel out. This scheme is more effective the smaller the head as a whole, because the cancellation relies on both gaps being situated in a uniform field, and the hum field is more likely to be uniform the smaller the physical extent of the head.

Unfortunately, once a tape deck has been purchased, there is little that can be done about hum pick-up from the motors if it should be too great. The deck used as a basis for the development of these circuits was found to be excellent in this respect. The first part of the circuit to be built was the playback amplifier, because with this in action, it was possible to play back pre-recorded tapes, and evaluate the performance with regard to speed-constancy, and playback response, without having to build up the whole of the recording circuits. No difficulty at all was experienced with hum, to the extent that it was not even found necessary to use a "humdinger" across the heater supply to the playback amplifier.

Another reason for the excellent performance in this respect is that modern low-hum, low-microphony tubes are used in the playback amplifier. Even during the last ten years, considerable advances have been made in valve design, and we would like to emphasize that valves such as the EF37A, which used to be reckoned as the best in this respect, are no longer in the swim compared with the modern noval tubes such as the EF86 and N709. Remarkable precautions are taken in the design of these tubes, even to the extent of connecting the pins in such a way as to balance out the effects of the remaining unavoidable but minute capacities between the grid pin and the two heater pins. Consequently it is really most injudicious to attempt the use of any other tubes in this position in the circuit. The stage gain of the first valve is approximately 150 times, after the shunting of the grid circuit of the second stage has been allowed for, so that at 1000c/sec., the output from the first stage will be of the order of 0.3 volts, and at 50c/sec., 15 millivolts. Now if we have succeeded in keeping the signal-to-hum ratio up to a satisfactory high level in the first stage, hum trouble in the second is extremely unlikely.

The second stage is also a conventional resistance-coupled amplifier, with the sole exception that it provides the necessary rising gain at low frequencies, through having been provided with frequency-dependent negative feedback. The feedback is from plate to grid, through a 250 $\mu\mu$fd. blocking condenser in series with a 470k. resistor. This combination has its turn-over frequency at almost exactly 1600 c/sec which means that this is the frequency where the low-frequency boost has reached 3db. Below 1600 c/sec., the boost increases, and keeps on increasing down to the lowest frequencies. Above 1600 c/sec., the boost becomes less, and in a very short space has disappeared altogether, after which the response is flat up to the highest frequencies. The whole response curve is very reminiscent of the equalization needed for British 78 r.p.m. records, except that here, the boost starts much higher up the frequency scale. Indeed,



DRILLINGS: A = 1⅛" Dia. B = ¾" Dia. C = ½" Dia. D = ⅜" Dia.

the circuit is almost identical with that used in many of our gramophone amplifiers for record compensation at 78 r.p.m., apart from the value of the feedback condenser.

At high frequencies, where there is no boost, the second EF86 has a stage gain of unity, so that this is so from about 2000 c/sec. At this frequency, the head output, multiplied by the gain of the pre-amplifier stage is between 0.6 and 1.2 volts, depending on the exact head output, which varies from sample to sample, and with the kind of tape used. Thus, there is plenty of output voltage from the second EF86 to drive all but the most insensitive audio amplifiers.

CHASSIS LAYOUT

This can be understood from reference to the photograph on page 22 of the previous issue, and to the chassis diagram included in this instalment. Referring to the photograph, we have the oscillator valve at the extreme right-hand back of the chassis, with the H.F. amplifier directly in front of it. To the left of the oscillator tube is the oscillator coil in its can, and in front of this is a dual 40 μfd. electrolytic condenser which actually forms part of the power supply circuit. To the left of these components are the two tubes of the playback amplifier. These, it will be noted, are close to the high-frequency oscillator and amplifier, because the playback amplifier is not on at the same time as the oscillator, so that the record amplifier can be placed as far away from the oscillator and amplifier as possible. This helps to prevent the H.F. from getting into the early portion of the record amplifier, where it could easily overload these stages, and cause distortion of the record. The valve in the extreme left-hand back corner is the first one in the record amplifier proper, with the second ECC83 to its right, also at the back of the chassis. The microphone pre-amplifier is in the front left-hand corner of the chassis, directly behind the two input jacks which can be seen at the left hand end of the chassis front, with a plug in the lower one, which is the low-level input jack.

The control knob to the right of the input sockets is the recording gain control. Next along the chassis front is the face of the magic eye, which is mounted underneath the chassis in a home-made bracket. Next comes the record/playback switch, followed by the playback output socket. In order to illustrate the layout just described, the photograph was taken with the chassis on the table in the usual way, but it was made in such a way that it can be stood up, on its back edge, close to the front of the deck. Thus if the two are put into a cabinet, the chassis can be attached to the front wall of the latter, and the deck can either be supported on legs made from heavy dowel rod, as in the photograph, or supported on battens fastened to the back and sides of the box. This arrangement places the controls of the amplifier in a row only an inch in front of the edge of the deck. The valves, electrolytic condenser, and coil can are all placed on the chassis so that when the unit is stood up with its front edge touching that of the deck, they all clear the "works" under the deck.

The single co-axial cable issuing from the right-hand end of the chassis is the one carrying the current to the erase head. It is brought through a hole lined with a rubber grommet, and is held down by a clip made from a piece of aluminium sheet, and held down to the chassis with a self-tapping screw. Just behind the face of the magic eye tube is the double co-axial lead to the record/playback head. These two pieces of cable are treated in the same way as has just been described for the other cable.

The under-chassis view can now be viewed with some knowledge of which circuits are where on the chassis. On top, the chassis looks as if there is plenty of spare room, but the space is needed for the rather large number of small parts that have to be accommodated, not to mention the magic eye tube.

(To be concluded)

Television in the Service of Science

(Reprinted from material supplied by "The Television Society, 164 Shaftsbury Avenue, London, W.C.2)

The Seventh Memorial Lecture of the Television Society commemorating the life and work of Sir Ambrose Fleming, the inventor of the radio valve, was delivered at the Royal Institution on Thursday, 19th January, by Professor J. D. McGee, of Imperial College. Professor McGee, who is well known for his pioneer work in the development of the Iconoscope, chose for his subject, "Television in the Service of Science," and considered in detail the possible extension of television techniques for scientific purposes into the infra-red, ultra-violet, and X-ray ranges of the spectrum.

Considering the infra-red radiation, two types of television microscopes were described. The first used a conventional light source and television camera tube, while the second microscope used a flying-spot scanner, photo-multiplier, and a display cathode-ray tube.

Conventional ultra-violet microscopes covering the range 2,000 Angstom units to 4,000 Angstom units have been designed and used, but they have the limitation that the operator cannot observe what is happening to the specimen. Television techniques using an ultra-violet sensitive photo-cathode together with a quartz window can overcome this defect. This technique has greater possibilities in the biological field and, in particular, for cancer research. Unfortunately, however, important though this field is, there are no such camera tubes available commercially at the moment.

Radiologists employ X-ray techniques in their investigations and diagnoses in the medical field. However, with present practice, observations can only be made under dark adapted eye conditions, and it is known that under such conditions the eye loses acuity. This loss of acuity can be overcome by using an X-ray sensitive camera tube, operating on the photo-conductive principle. Existing image intensifier fluoroscope techniques could be extended by replacing the small viewing screen with a storage surface and scanning this in the normal manner to produce a television signal. For the observation of any rapid movement, the lag normally associated with photo-conductive surfaces would have to be overcome.

The detection of gamma-rays which are of even shorter wavelength than X-rays is at present being achieved by a phosphor/photo-multiplier combination. The quantum efficiency is, however, exceedingly low and the storage principle could be of great use.

(Continued on page 50)

WILL WE GET THEM HERE?

What are the chances of picking up in New Zealand the Australian television transmissions on Band I? This short article attempts to answer this interesting question.

With the advent of television broadcasting in Australia this year, many New Zealanders interested in radio are wondering whether or not the transmissions from the other side of the Tasman will be receivable in this country. Unfortunately, it is not possible to answer this by a clear-cut "yes" or "no", but the possibility is there, and seems to provide excellent scope for the amateur experimenter. It is well known that to receive and display a satisfactory television picture requires a much greater signal strength than merely to achieve satisfactory speech or morse communication. It will certainly be an exciting event if anyone should succeed in receiving pictures from approximately 1200 miles away. If someone does succeed, it is not difficult to envisage a surprising amount of amateur activity in this line, but there is one rather important scientific aspect of the question that many amateurs will be unlikely to take much interest in. We refer to the increasing of our knowledge of ionospheric propagation of radio signals.

RESULTS COULD BE IMPORTANT

Although the last two decades have seen very important advances in our knowledge of ionospheric propagation of radio waves, and consequent advances in the accuracy with which predictions can be made of the maximum usable, and best working frequencies for long-distance communication, there is still a great deal to learn, and the scientists responsible for research into these matters are for ever on the lookout for new information, however meagre and unimportant it may appear to the uninitiated. Thus, anyone who may have success in receiving Australian TV transmissions in New Zealand will have obtained exceedingly useful information, provided it is communicated to the right quarters, with details of times, type of receiving equipment, etc. Indeed, the fact that we are able to make any sort of attempt at evaluating the possibilities, is due solely to the advanced state of our ionospheric knowledge at the present time, and to such reports of unusual reception conditions, as well as to organized research.

THE TIME FACTOR

As most readers are aware, the reception of high frequencies via reflection in the ionosphere is not static, but varies according to time of day, time of year, and yet again according to an even longer cycle of events which recurs once in approximately eleven years. In attempting long distance reception of frequencies which, like the lower television ones, are too high for every-day use by ionospheric reflection, all these cycles have to be taken into account. The transmissions we are interested in cover a band from 63 to 70mc/sec. These frequencies are normally much higher than the Maximum Usable Frequency between Australia and New Zealand, and so can not expect to be received under normal conditions. However, the ionospheric cycles already mentioned manifest themselves in the following way. The Maximum Usable Frequency varies, and at the peak of each cycle is at its greatest value. For example, taking the daily cycle, we find that the M.U.F. is greatest on any one day, between the hours of noon and, say, 3 p.m. Similarly, the M.U.F. reached each day varies through the year, this variation constituting the annual cycle. It is known that the greatest daily M.U.F.s occur during the summer months, so that if we are looking for reception from afar on higher-than-usual frequencies, it is obviously no use trying in the middle of winter, or in the middle of the night.

These daily and annual variations of M.U.F. are superimposed on an eleven-year cycle, such that the greatest M.U.F.s are found to occur every eleven years. In this way, we can organize our attempts to get long-range communication on about 65mc/sec., by knowing where we are on the 11-year cycle, and then confining our activities to the middle of the day in the middle of summer.

PRESENT STATE OF AFFAIRS

Fortunately for us, we are at present near the peak of an 11-year cycle. The last one had its peak in 1946-57, so that the next peak will be in 1957-58, and conditions for high-frequency reception are at the present time well up towards the peak. Thus, the next three summers should be the best times for trying to receive Australian TV, unless we want to delay our activity for another eleven years—by which time we MAY have our own to look at without worrying about anyone else's! On the other hand, we may not.

HAS IT BEEN DONE BEFORE?

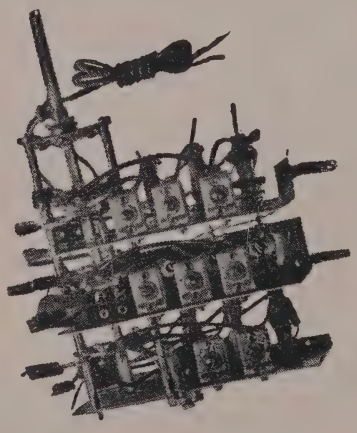
Obviously if the above refers to TV reception in New Zealand from Australia, the answer is in the negative. What we mean by the query is, "has long-range reception on 65mc/sec. been attained before in any other part of the world?" As to this exact frequency, we do not know, but there is a well authenticated case, which occurred in November 1946, when an English amateur received transmissions from America on 50mc/sec. for several hours at good strength. This is the nearest example we have been able to find of the sort of thing we are looking for, and there are important differences between this case and our own problem. Firstly, the distance was some 3500 miles. Contrary to what might be expected, this is the wrong answer from our point of view, because the higher the frequency, the greater skip distance, and therefore the greater the range at which reception might be expected, to the exclusion of shorter ranges. In other words, if the signal is actually reflected by the ionosphere, this does not mean that we shall receive it, because it may be going right over our heads, as it were, and coming down to earth much farther from Australia than we are. This assumes that the transmission is

a single-hop one, in which case it is reflected from the ionosphere only once between the transmitting and receiving points. Multi-hop transmission is possible, and does occur, but there is very much less likelihood of its taking place, the higher the frequency. That is, when a fixed path between two given points on the earth's surface is considered, as here. It comes about in this way. The higher the frequency, the more obliquely it must strike the ionosphere if it is not to pass through it. Thus, if we consider the path between, say Sydney and Wellington, when the M.U.F. is lower than our desired 65mc/sec., there can be two reasons why we cannot receive this frequency from Sydney. Either it is not being reflected by the ionosphere at all, or else if it is, the angle of incidence at a point in the ionosphere midway between the two places is such that Wellington is being skipped over. Thus, there is a critical angle of incidence at which reflection just takes place, and this, in turn fixes the distance of the reflecting point from the transmitting station. Since the radiation can be regarded as travelling in straight lines, this gives a minimum distance—the skip distance—over which no communication is possible.

The next difference is that the frequency was considerably lower than 65mc/sec. This does seem to pose a problem, in that the highest frequency on which ionospheric propagation has been known between Australia and New Zealand is the amateur band from 50 to 54mc/sec. This is some 20% lower than 65mc/sec., so that considerably higher M.U.F.s are needed than for communication on the 54mc/sec. amateur band, if success is to be assured.

However, nothing is known as yet about 65mc/sec., because it has not been tried over this path, so that we may be in for some pleasant surprises. In addition, some recent work done last December shows that the present methods of predicting M.U.F.s give results that are some 5% low, which is an error in the right direction for our purpose.

All things considered, it is by no means impossible that 65mc/sec transmitted from Australia should be received here, and in our opinion attempts are well worth while. Accordingly, we propose to design and publish in an early issue of this journal, details of a converter, to be used with a normal communications receiver in the first instance, which will enable anyone to tell whether the transmissions are receivable at all. If they are, the same converter can then be used as the front end of a proper television receiver to display the picture in the ordinary way.



Poly-Q

B-A-N-D
S-P-R-E-A-D

BASIC KIT — TYPE 9

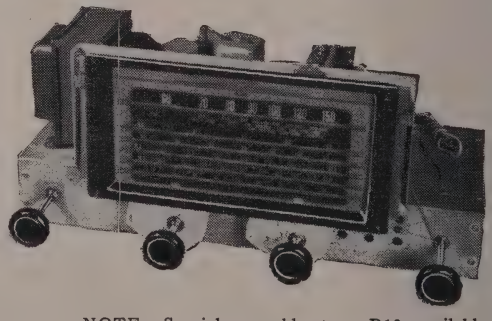
Completely assembled, wired, and tested up to converter tube. Fitted to sturdy 8/9 valve, plated steel chassis. Accurately aligned to dial calibation. You merely add I.F. and audio stages. The spread on shortwave makes shortwave tuning easier than broadcast.

IDEAL as base for really high-quality
RADIOS, TUNERS, RADIOGRAMS, etc.

Details:
49, 31, 25, and 19-metre bands, plus broadcast. Extremely accurate calibration and frequency stability. Split stator tuning condenser and temperature compensated oscillator. Only three simple adjustments necessary to completely align each bandspread. Handsome floodlit dial scale. Effortless tuning from high ratio 24/1, ball-bearing spin wheel drive. Gang isolated from mechanical and electrical vibration and noise. Bandspread calibration linear and marked in 100 k/c divisions and fractions thereof. A 0–100 logging scale also provided. "BAND", "TONE" and "GRAM." indicators fitted. Special A.V.C. system provides shorter time constant on shortwave to rapidly compensate for fading signal. Polystyrene low-loss adjustable slug coils throughout. Full instructions and suggested I.F. and audio circuits.

Price:
£16/19/7 (retail), less valves, plus packing, and postage.
(Valves, £1/5/6; packing, 6/6; postage, 6/6, approx.)
See them at our Stockists, or write direct for full particulars.

INDUCTANCE SPECIALISTS LTD.
157 THORNDON QUAY : WELLINGTON



NOTE: Special assembly type B10 available covering amateur bands 15/13, 20, 40, 80, 160 metre bands plus broadcast also available.

CATALOGUE: New list of preferred types available on request; specially prepared folder including list and technical data sheets 2s. 6d.

NEW ELECTRONIC PAGING SYSTEM

DISPOSES OF USE OF LOUDSPEAKERS, NOTICEBOARDS OR FLASHING LIGHTS

An ingenious new type of paging system for use in hospitals, institutions, large offices and factories, etc., setting a new standard for quiet, unobstrusive and selective operation, has been developed by the Sydney firm of Both Equipment Ltd.

The Both Paging System works on batteries, and is quite different from the usual visual or auditory type of paging system which is addressed without selectivity to everyone within sight or sound of the signal. In the Both system there is no loudspeaker or public-address system, no notice board or flashing lights to be watched. Only the person receiving the signal knows that he is being paged. It does not matter where he is—so long as he is within the building or plant within which the apparatus is installed, its message will reach him.

The new paging system is of outstanding value in hospitals, where quiet is essential. One of Sydney's best-known public hospitals, the Royal Alexandria Hospital for Children, recently installed Both paging equipment so that doctors in the wards could be called without any disturbance to patients and medical and nursing staff.

Besides its use in hospitals, the equipment can be installed in factories, department stores, warehouses, offices and industrial plants and other large organizations—anywhere where there is a need to contact scattered and roaming personnel.

OPERATION IS SIMPLE

The apparatus consists of a microwave transmitter, control desk, aerial wire and a number of receivers. The aerial wire, for transmitting the signals, encircles the building, plant or ground which is to be covered by the paging system. Each end of the aerial is connected to the transmitter, whose output is in relation to the area to be covered.

Operation is extremely simple. An operator sits at the control desk and transmits a signal to a particular receiver by depressing a correspondingly numbered key on the control board, which has keys projecting in banks, as in a typewriter keyboard. Depressing the key produces a signal which continues until the key is released.

POCKET RECEIVERS

Each person who is to be contacted carries a pocket-size receiver set for a particular frequency, in a range below 10,000 cycles. The transmitted signal is received only by the receiver set for that frequency. The signal is perfectly audible to the person carrying the receiver, but not to anyone else. It can be received anywhere within the area encircled by the transmitting aerial.

All the component parts of the apparatus are distinguished for compact and modern design. The transmitter is housed in a mobile cabinet beneath the control desk. The desk itself is of neat and attractive design, and can most conveniently be placed near the telephone switchboard. It should have an alphabetical key to the holders of the receivers alongside for quick reference.

The receivers are made of black moulded plastic, measuring 4¾ in. by 3in.—small and compact enough to fit comfortably into the pocket. There are no wires or leads attached. When not in use, they are kept on a storage rack within the control desk.

OPERATION ON TORCH BATTERIES

The receivers operate on pencil torch batteries. There is a minimum battery drain, being approximately 1/300th of the current drawn by a torch globe. The batteries last approximately the normal "shelf" life.

As many persons as have receivers, up to a total of 50 can be contacted individually without any other person being aware of the call. Only a fraction of a second is needed between calls. The number of recipients can be increased, if necessary, by using coded signals. Or a code of signals can be evolved to send messages. For instance, a long and short signal could mean that the person paged is required at a particular location.

If the receiver is to be used in a particularly noisy area, special ear-pieces similar to a hearing aid are available. These enable the signal to be received despite the noise.

This paging system can be installed by any competent electrician, without any alteration to existing buildings being necessary and without excessive expense being incurred. Cost is within the range of the average industrial organization; upkeep and maintenance costs are negligible.

CLASSIFIED ADVERTISEMENTS

Rates 4d. per word, minimum charge 3s. Deadline date 1st of month preceding publication.

BACK NUMBERS OF "R. & E."

Available from our Office,

Plessey

RADIO COMPONENTS

Variable Capacitors, Air and Compression Trimmers, Drives and Couplings, Vibrators, Chokes and Transformers, I.F. Transformers, Wavechange and Toggle Switches, Valve holders and Pilot Lamp-holders, Loudspeakers, Iron Dust Cores and Formers, Potentiometers, Cascap and Caslam Capacitors, Electrolytic Capacitors.

New Zealand Representative:

WILLIAM J. BLACKWELL

P.O. Box 1622. ——— Auckland

For the Amateur

THE ADVANTAGES OF SINGLE-SIDEBAND

It is a pity that so many advances in radio, as in most other fields of endeavour, are made only at the cost of increasing complexity of equipment, and of the learning of new techniques. Such is progress, however, and because it is always worth-while, we hope that more and more amateur transmitters are doing something about single-sideband transmission and reception. This article pin-points some of the advantages of the new technique and shows that it is not so difficult as might at first be thought.

INTRODUCTION

Perhaps the first thing to say about single-sideband transmission is that it is not just a theorist's dream —it really works the way theory says it should— provided (and here comes the rub, you say) provided it is done properly. Don't, whatever you do, let anyone talk you out of it by recounting tales of the S.S.B. signals he has heard that take up half the band. Loose talk of this sort can be written off as amateur licence, but not the sort that you can get by passing the examination and paying for your ticket at the nearest G.P.O.! Like anything else, the results can be horrid if the job isn't properly done in the first place, and then people who just can't be bothered anyway use these results to try and make out that it's the system that is at fault, not ZL2PQR's transmitter, and certainly not the complainer's receiver! To say that S.S.B. is no good, just because (a) you can't be bothered about it yourself or (b) because you have heard someone else's not very successful attempts at it is as ridiculous and unscientific as saying that a violin is a shocking instrument anyway, just because you can't play yourself.

Of course, this sort of thing is an extreme case, and is becoming rarer. It is bound to, as the devotees of S.S.B. increase in number and in the success of their results.

NOT SO HARD REALLY

If we have succeeded in convincing you that there is a case for single sideband, the next thing we hope to do is to persuade you that it is really not so difficult, either to do or to understand, as you might suppose. If you have already read all that "QST" has written on the subject, then you might be better off going away and doing something about it than reading this article, because we must acknowledge that most of the information given in this article is culled from that source, together with practical experience gained by developing circuits similar to some of those that have been put forward in that magazine. However, if you have not, we hope that this article may put forward some useful explanations showing just what advantages one can hope for by using S.S.B. transmission. It is perhaps significant that although the original "QST" articles on S.S.B. were published over six years ago, it is estimated that no more than twenty or so New Zealand amateurs are on the air with S.S.B. transmissions at the present time. The actual significance of this statement is something on which we would prefer not to comment, but it is hoped that this number may show a worth-while increase in the not-too-distant future.

THE CONVENTIONAL 'PHONE SIGNAL

Perhaps the best and easiest approach to S.S.B. is to compare it with conventional amplitude-modulated transmission. In order to do this, it is necessary to see what makes up an a.m. signal, and to do even this much, we must look not at a signal representing the carrier modulated with speech or music, but one modulated with the simplest possible audio signal, namely a pure tone.

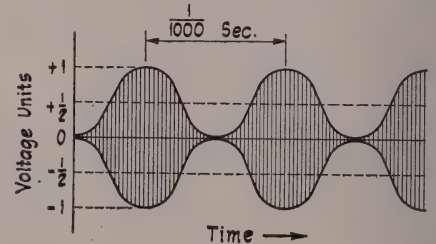


Fig. 1

Most people, if asked to draw a picture representing such a signal would come up with something like Fig. 1. This illustrates how the amplitude of the R.F. signal varies with time, at a rate equal to that of the modulating frequency. Since the variation is from twice the carrier amplitude to zero, this picture represents 100% modulation. The time scale in such a picture is arranged so that one complete cycle of the modulating frequency can easily be seen, and as this frequency has been specified as 1000c/sec., the time elapsing between corresponding points on successive cycles is 1/1000 second. It is important to note that this diagram is one showing how the **amplitude** of the R.F. output varies with **time.** This is the most easily understood picture of a modulated carrier, but there is another, equally true method of illustrating it, and this is shown in Fig. 2. This is a graph showing **amplitude** against **frequency,** and is interpreted in the following way. The carrier, which is a single frequency, is represented by a vertical line, at its own particular point on the frequency scale— in this case 4.0mc/sec., or 4000kc/sec. Since the carrier is only a single frequency, it cannot take up any space in the picture horizontally, and so the line representing it should be infinitely thin. However, an

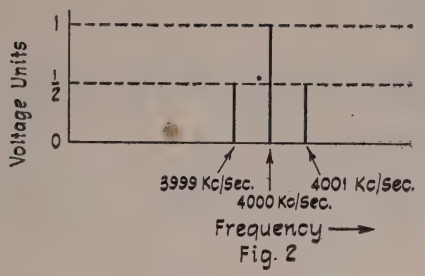


Fig. 2

actual thin line, while it has definite thickness, indicates what we mean sufficiently well. The amplitude of the carrier has been set at 1 voltage unit, just as in Fig. 1.

If the carrier were unmodulated, the signal would be completely represented by this one line at the carrier's frequency. However, when it is modulated, two other frequencies appear, and their amplitude is directly proportional to the depth of modulation. Each of these new signals is spaced from the carrier by an amount on the frequency scale equal to the modulating frequency, as indicated on the diagram, so that in our example, their frequencies will be 3999 and 4001kc/sec., respectively. Their amplitudes are exactly equal, and have been drawn at ½ a voltage unit on the amplitude scale. This is the amplitude they reach when modulation is exactly 100%, so that Figs. 1 and 2 correspond exactly. They are merely different ways of illustrating the same thing.

These days, the idea that modulating a carrier at (to it) a very slow rate which produces new frequency components is easily accepted by most of us, but it is sometimes a difficult conception for newcomers to grasp. This is no wonder, because the original conception of Fig. 1 as a complete description of a modulated R.F. signal was for many years the only one that even the best engineers and scientists could grasp. It was a mathematical investigation which first indicated that the additional, or side-frequencies, as they are now called, exist, and at the time, there was a first-class argument among the pundits as to whether they actually do exist, or whether they are merely a mathematical invention, like the square root of —1! In those days it was rather difficult to prove practically that the side-frequencies were actually present, but today, we have receivers selective enough to tune through a signal like the one illustrated, and pick out either the carrier or either of the side frequencies, just as we choose.

Usually, however, modulation is not so simple as to consist of a single tone, and in the case of speech or music, the modulation waveform contains a very large number of frequencies, all of which modulate the carrier at the same time. Thus, instead of a single modulating frequency, we have a large number of them, and each turns up in the modulated signal as a radio-frequency signal with a frequency of its own, determined by the carrier frequency, together with its own original audio frequency. Thus, the intelligence with which the carrier is modulated is converted to a **band** of radio frequencies close to the carrier, and becomes known as a **sideband.** Just as in the case of the single modulating frequency, each modulating frequency is converted into two radio frequencies, one higher, and the other lower than the carrier frequency, so that the complete complex signal comprises the carrier and two sidebands, known as the upper and lower sidebands, for obvious reasons.

WHY TWO SIDEBANDS?

At this point, the inquiring reader might be forgiven for asking why there are **two** sidebands, because all the information we want to transmit is contained in only one sideband. Each of these comprises a set of frequencies differing from the original audio frequencies only because a fixed frequency has been added to them (in one case) or because they have been subtracted from the same fixed frequency (in the other). It is easy to imagine, and in practice it can easily be done, that if we had a signal consisting only of one of the sidebands, we could change it back to the original set of audio frequencies by a process of frequency changing. If this is the case, then the second sideband and the carrier are certainly unneeded.

Why, then, do we not have a method of modulation whereby only one sideband is generated in the first place? The answer is beyond the capacity of the present writer to answer, because no such method has yet been invented. All attempts to modulate a carrier result in the generation of both sidebands, and it seems to be one of the laws of Nature that this should be so. However, there are methods of circumventing the laws of Nature, if not of breaking them, and these methods constitute the means whereby single sidebands can be generated and transmitted.

WHY USE ONLY ONE?

Those who have glanced at some of the circuits used for generating single-sideband signals will not have failed to notice their apparent complexity compared with the methods used for obtaining an ordinary A.M. signal containing both sidebands and the carrier. This complexity arises not so much because the methods used are complicated in principle, but rather because each method requires a number of steps to be accomplished before the final result is arrived at. It is not unnatural to ask, therefore, what advantages S.S.B. has, that make it worth while going to all this trouble. Fortunately, most of the information we need in order to evaluate S.S.B. is contained in Fig. 2. Here, the carrier and side tones have been represented as voltages, the assumption being made that these voltages are being produced by a transmitter across a fixed load resistor. Thus, we can use Fig. 2 to work out in very simple fashion the distribution of power between the carrier and the sidebands, once again simplifying the matter by assuming that the intelligence to be transmitted is a single audio tone.

Now if the load resistance is fixed, as we have assumed, the power dissipated in it is proportional to the square of the voltage across it. Taking the carrier voltage as 1 unit, the power in the carrier can be represented by the figure 1^2, which equals 1. Thus we can say that the carrier represents 1 power unit. The lower sideband, for 100% amplitude modulation, reaches a voltage of ½ a voltage unit, so that its power can be represented by $(\frac{1}{2})^2$, or ¼ power unit. The upper sideband is identical with the lower one, so it too can be represented by ¼ power unit. The total power in the modulated signal is then got by adding up the powers in the carrier and sidebands,

(Continued on page 31)

The PHILIPS Experimenter
An advertisement of Philips Electrical Industries of N.Z., Ltd.

No. 107: A Panoramic Adaptor for Amateur Receivers—Part 3

OSCILLATOR COILS

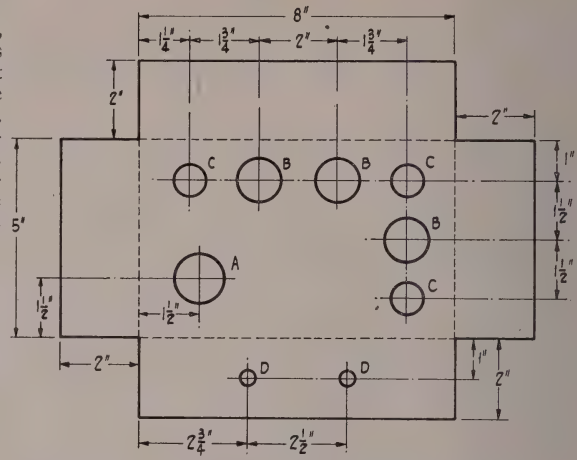
The coils for the oscillator are not standard items, and will have to be wound by the builder. There is nothing difficult about them however, and a slight mistake in the numbers of turns will have very little effect on their performance. They are wound on a 1 in. diameter bakelized paper coil former, with terminating lugs riveted to them. The one for L_1 is $1\frac{3}{8}$ in. long, and that for L_2 and L_3 is $1\frac{1}{8}$ in. long. L_1 comprises 150 turns of 42 gauge wire, wound in a single close-wound layer, and tapped at 60 turns from the end connected to the screen.

L_2 and L_3 have identical numbers of turns, and are wound one over the top of the other in order to give as close coupling as possible. After the first winding has been put on, it is held down with polystyrene coil dope, after which a layer of typing paper is wound over it, and doped in place. The second winding is then put on exactly over the top of the first one. It does not matter which winding is used for L_2 and L_3, although they must be connected in the correct polarity relationship, otherwise oscillation will not occur. L_2 and L_3 each have 50 turns of the same wire as was used for L_1. In the underchassis view printed in the last instalment, it will be seen that the coils are mounted at right-angles. The one whose axis is parallel with the sides of the chassis is the one with L_1 on it, and its 1000 ohm shunt resistor can be seen mounted across it. This coil is supported about half an inch above the chassis in the following way. A five-lug strip of insulated tie-points is placed on the chassis just where the left-hand edge of the coil former is wanted. The two ends of the coil are connected to solder lugs at each end of the former, and in line with each other. It is then possible to solder the lugs on the coil former to two of the lugs on the strip, and these lugs then act as well as tie-points for the connection of the coil ends to the remainder of the circuit.

The other former is mounted on the end of the chassis in a similar way, on a tag-strip with two insulated lugs, one on either side of the earthed mounting lug.

CONSTRUCTIONAL DETAILS

The chassis used was a stock type measuring 8 in. × 5 in. × 2 in., and a lay-out diagram showing the main holes required is printed here. The EF80 input valve is at the right-hand front end of the chassis. Immediately behind it is the 455 kc/sec. transformer, and behind that again is the ECH81, which can just be glimpsed in the photograph. Then, along the back of the chassis, are the two 100 kc/sec. I.F. transformers, I.F.T.2 and I.F.T.3, and the ECC82. Directly in front of this valve is the EF50 oscillator. The two controls on the front of the chassis are the 5k. wire-wound potentiometer, which is used for accurate set-



Working drawing for chassis of Panoramic Adaptor.

ting of the centre frequency, and the 500k. potentiometer, which is the sweep-width control. The first of these is close to the EF50 socket, as it has R.F. flowing in the leads and in the potentiometer itself. The leads from the other control do not need to be so short, because they carry only the 25c/sec. saw-tooth voltage, which is fed into the unit through the 0.25 μfd. condenser at the right of the circuit diagram.

Input and output leads are of co-axial cable taken in through small holes in the chassis, lined with rubber grommets. The outer P.V.C. covering is bared so that the portion of the cable inside the chassis can be soldered to a convenient earth-point, close to where the inner wire has to be connected. The saw-tooth input lead is taken in near the front right-hand corner of the chassis, as is the R.F. input lead from the receiver. The output lead is taken through the left-hand side of the chassis close to the ECC82. No blocking condenser has been shown on the circuit diagram in this lead, but one will have to be included in order to block the D.C. at the mixer plate in the receiver. It is best connected at the receiver, however, so that it has been left off the present diagram. The 10 μμfd. coupling condenser between I.F.T.1 and I.F.T.2 cannot be seen in the photograph, but is wired as directly as possible between the appropriate leads on the transformer bases. These should therefore be oriented so as to put the secondary leads of the first close to the primary leads of the other. The large condenser in the upper right hand corner of the under-chassis photograph is the 0.25 μfd. coupling condenser to the voltage divider

containing the sweep control potentiometer. It is supported near the folded edge of the chassis on a tag strip specially placed there for it. For the rest of the components, liberal use has been made of tag strips so as to avoid loose resistors and condensers floating in the wiring without proper support. There is nothing particularly critical about the layout of the small parts, but bypass condensers should all be placed as close as possible to the points they are supposed to bypass, especially in the oscillator and mixer portions of the circuit.

SETTING UP THE CIRCUITS

There is nothing difficult about aligning the circuits of the adaptor, but the job should be tackled in a logical manner from the back end forward. The oscilloscope that is to be used with it can be used as the output indicator, and the oscillator can act as its own "wobbulator". All that is needed is a signal at 100kc/sec., and another at 455kc/sec., capable of being varied around that nominal frequency, but preferably calibrated in frequency.

First of all, the 100kc/sec. channel must be lined up. To do this, the EF50 is unplugged, and a 100 kc/sec. signal is fed to the grid of the ECH81, the connection to the secondary of I.F.T.$_1$ being temporarily broken. If the signal is modulated, the amplitude can be judged by the height of the pattern on the oscilloscope. For this it is best to run the time-base at a few thousand cycles per second, as this will give a horizontal line when there is no output from the detector, and a band, of width proportional to the output amplitude when the modulated signal is applied. Make sure that the oscilloscope amplifier gain is kept down so that the band covers no more than about half the tube height. In this way there will be no possibility of amplifier overload obscuring the true behaviour of the output voltage as the trimmers are adjusted. The second 100kc/sec I.F. transformer should be aligned first, working back from secondary to primary. Then the first transformer is peaked up in the same order, and finally a return is made to the second transformer to make sure that there has been no interaction. This done, the EF50 is replaced in its socket, and the signal generator is turned to 455kc/sec., and is fed into the grid of the EF80. With the 500k. pot turned right down, so that there is no modulation voltage applied to the oscillator, I.F.T.$_1$ is roughly aligned by tuning its windings for maximum response on a modulated signal, after this has been tuned in by means of the 5k. potentiometer in the oscillator circuit. If the oscillator coils have been made according to instruction, no other tuning control will be needed, and it will be found possible to tune in the 455kc/sec. signal with the 5k. pot, which acts as an electronic tuning control. When this has been done, the next step is to set the scope's time-base to approximately 25c/sec., and to turn up the modulation control slowly. For this test the modulation on the signal generator is best turned off. As the modulation, or sweep control is turned up, a peak will show in approximately the centre of the trace, and as the control is advanced further, the peak will get narrower, indicating that the wobbulated oscillator is being swept over an increasingly wide band of frequencies. If too much voltage is applied, a time will come when the position of the peaked response on the screen also commences to change. This indicates that the oscillator is being over-swept, so that its change of frequency is no longer proportional to the sweep voltage. This is the maximum linear sweep that can be obtained, but it will be found later that the available sweep is much greater than can be used, for other reasons altogether. Set the sweep control so that the base of the response curve on the screen occupies about a tenth or less of the total trace length. If all is well, this should be possible well before the peak starts to move sideways, and measurement with a ruler will show that the peak is quite accurately placed in the centre of the trace. All that now remains is to align the input circuits, and this is the most difficult part of the whole procedure.

In order to carry this out, it is best to attach the adaptor to the receiver with which it is to work. Then, any signal can be tuned in on the receiver, and the tuning dial used to tune it to frequencies at and about the nominal 455kc/sec. First of all, it is necessary to re-tune the plate circuit of the receiver's mixer, since the attachment of the adaptor will in all probability have shifted it slightly from its proper frequency. The aim thereafter is to detune the windings of I.F.T.$_1$ on either side of 455kc/sec., so that there is a substantially flat response at the input of the ECH81 mixer, from some 30kc. below to 30kc. above that frequency. The job must be done by trial and error, but in an organized way. Definite instructions cannot be given because the final result will depend not only on the I.F. transformer used in the adaptor, but also on the selectivity of the receiver, as seen at the plate of the mixer. First of all, pick up any steady signal on the receiver, and tune it in by ear in the usual way. When this is done, it will be found on the screen of the C.R.T. as the usual kind of "pip", which is actually a response curve of the selective 100kc/sec. section of the adaptor. Then, watching the pip on the screen, move the receiver's main dial to either side of the proper tuning point and watch what happens. Since I.F.T.$_1$ has been peaked at 455kc/sec. previously, it will be found that the tuning cannot be moved very far before the amplitude of the pip decreases rapidly. If a tracing of the tip of the pip were made, as it moves when the tuning of the receiver is changed, the tip would trace out a curve which is the selectivity of the receiver and the adaptor, up to the ECH81 grid. Next, set the receiver to a frequency 10kc/sec. away from the proper tuning point for the signal. Then adjust one of the trimmers of I.F.T.$_1$ so as to bring up the amplitude of the pip to something like its original value (i.e., the value at the centre point). Then, move the receiver tuning to a point 10kc/sec. on the other side of the tuning point for the signal, and repeat the operation, this time de-tuning the other trimmer of I.F.T.$_1$. Then sweep the signal over the I.F. range again, and note that there is now a more extensive patch in the centre of the oscilloscope where the pip's amplitude remains high. The trimmers of I.F.T.$_1$ are then set slightly further out from 455kc/sec., until the signal pip retains useful amplitude over a greater range still. When this is done, it will probably be found that the overall response around 455kc/sec. now exhibits three peaks—one at the centre, and one on either side, with more or less deep valleys in between. In order to obtain the flattest response over a range of some 60kc/sec. total bandwidth, it may be found necessary to shunt resistance across either or both windings of I.F.T.$_1$. The effect of these will be to lower the Q of the windings and make their

response broader, at the same time reducing the overall amplitude. This can be restored by turning up the vertical gain control in the oscilloscope, so that if these resistors can be made to render the response wider and flatter, it is worth while to use them.

When the 455kc/sec. response has been made as wide as is practical, without reducing the response too much at any point on the face of the scope, the sweep control can be set so that the band over which the pip has useful response is just accommodated on the screen. Reducing the saw-tooth input will reduce the frequency sweep, and will thus expand the picture sideways. Then, any signal which comes up inside a band around the nominal frequency to which the receiver is tuned, will show as a response pip on the screen, while the signal which is tuned accurately on the selective main receiver will show in the centre of the oscilloscope trace. It then becomes possible if desired, to calibrate the trace or the sweep control in terms of kilocycles off resonance, and to listen to one signal while watching the screen for any others that may pop up within, say 30kc/sec. either way of the signal being received. Alternatively one can set the receiver to a given frequency, and observe when the expected signal appears. It is likewise possible to find a "hole" in a crowded band and to set the V.F.O. right in the gap, being assured that for the time being at least, no other signal within range of the receiver is interfering with your own transmission.

N.Z. ELECTRONICS INSTITUTE—WELLINGTON BRANCH

AUGUST MONTHLY MEETING

Nearly 40 members and visitors, including members of the N.Z.B.S. attending the current technical trainees' course held by the N.Z.B.S., were present at the August Meeting of the Wellington Branch of the New Zealand Electronics Institute.

Principal speaker was Dr. B. C. Lee, Supervisor of Technical Education, whose subject at the special request of the branch, was "New Zealand Certificates of Engineering".

Opening his remarks, Dr. Lee drew attention to the need for trained people in this age of automation and the greater need for skilled people to maintain the complex machines of today. Dwelling on the shortage of engineers, he defined the terms "engineer" "technologist" and "technician", pointing to the need for technologists with a sound grounding in mathematics, basic theory and a practical knowledge of their particular science. Such technologists are urgently needed to assist the professional engineer.

Discussing the syllabus for the New Zealand Certificate in Engineering (a 5-year course), the Endorsed Certificate (6 years), and the New Zealand Engineering Certificate (4 years), Dr. Lee explained the planning of the courses to meet particular needs. Except where exemptions are permited for equivalent examinations, it is necessary for the student to attend the full course and sit for each examination.

Rewards for Qualifications?

During question time, a member inquired about the reward which might be expected to follow the gaining of this qualification. He pointed out that, in these days of full employment, many boys straight from school might prefer to accept an unskilled job which, financially was equally rewarding, and moreover required no study. Alternatively, faced with a six years' course in any case, many boys might prefer to take that for a recognized degree.

Even now some Government Departments were considering how to recognize this examination in their salary structure, said Dr. Lee, but, as yet it was rather too early to expect such recognition in the form of salary levels.

What of People of Mature Age?

The speaker was asked about the position of those of mature age already holding positions where they were performing the duties for which the Certificate was designed to qualify them, and who, at the age of 40 or thereabouts, could hardly be expected to go through the course. Inquiries were also made concerning the position of those who, with no formal training in certain of the subjects but with some years of experience, had acquired a standard of knowledge sufficient to enable them to sit for the examination without first having to undergo the complete course.

In his reply Dr. Lee advised that the matter of recognizing experience in the award of the Certificate was under consideration, but with regard to the second question, it would still be necessary for the candidate to cover the course before taking the examination.

Overseas Recognition of the Certificate?

To a query concerning the recognition accorded the Certificate by Overseas Qualifying bodies, Dr. Lee replied that, as yet, it was too early to seek recognition overseas. This must await the proving of the standard by sample examination papers, etc.

Examinations for Television Servicemen

The second part of the programme was devoted to a short address given by Mr W. D. Foster, B.Sc., M.T.S., M.N.Z.E.I., on the examination for Television Servicemen conducted by the Trades Certification Board. Explaining that it was hoped to train servicemen in television servicing techniques in preparation for the introduction of a TV service in New

(Continued on page 51)

AUDIO FANS TAKE NOTE

High Fidelity Sound Systems of New Plymouth specialize in HIGH QUALITY SOUND SYSTEMS from 5 watts to 50 watts output, ready made or designed and built to your requirements. We are experts in this field and can advise you on all High Fidelity Sound System problems.

We carry a full range of high quality accessories. Drop us a line, we may be able to help you.

HIGH FIDELITY SOUND SYSTEMS
4 Tothill Street ——— New Plymouth

Single Sideband

(Continued from page 27)

and obviously comes to 1½ power units. Translated into terms of actual powers, this means that a transmitter with a carrier power of 100 watts, radiates two sidebands, each of 25 watts, and totalling 50 watts, when modulated 100%. Thus, the transmitter's final amplifier must be capable of producing a total power of 150 watts if it is to transmit a fully modulated carrier of 100 watts. Moreover, the power in the sidebands must be provided by the modulator valves, in the common case of a plate-modulated transmitter, which incidentally explains very easily why it is that the audio power output of the modulators must equal 50% of the D.C. input to the final amplifier if 100% sine-wave modulation is to be obtained. Now the big point about single sideband is this. The thing we are really interested in transmitting is not the carrier, but the modulation. Nor are we interested in transmitting at the same time, two identical signals, each of which represents the modulation completely. Therefore, if some means can be found of transmitting one sideband only, without the carrier, we can put into the ether as much useful communication signal as the conventional 100 watt transmitter, by sending out only 25 watts. This is only one-sixth of the power transmitted by the A.M. transmitter. If we have a final amplifier capable of putting out a continuous power of 150 watts, we will hardly be using its capabilities if we ask it to turn out a mere 25 watt sideband. Instead, we can increase the input signal until it again produces its 150 watts, which now will all be useful communication signal. In this way, the same final amplifier valve can be made to give six times the useful power output that it did when it had to handle an extra sideband, and a carrier, neither of which add anything to the useful communicating power. This six-fold increase represents a signal gain of 7¾db. compared with the original A.M. transmitter.

There is a further gain, too, that can be made when we realize that we have based the above calculation on the **continuous,** or single-frequency power output of which the final amplifier is capable. In practice, speech waveforms are of a transient nature. That is to say, the waveforms are not steady, but are continuously changing, so that a more real estimate of the capability of an R.F. amplifier running Class B or Class C can be made by considering the **instantaneous peak power** of which it is capable, rather than the continuous power. If peaks, of short duration, are applied to the stage, it is able to produce for brief periods, powers considerably in excess of that which it can generate continuously, for any length of time. Indeed, during the generation of a conventional 100%-modulated A.M. signal, the final does have to handle peak power equal to four times the carrier power. It would seem reasonable, therefore, to suppose that the same valve, handling speech in single-sideband form, could handle the same peak power that it does in ordinary A.M. service. If, therefore, we allow it to do this by still further increasing the input on peaks, we can reckon the single sideband output as a **peak** power of 400 watts.

Now in the A.M. case illustrated in Fig. 2, we have an R.M.S. power in each sideband of 25 watts for a 100 watt carrier. The peak power in one sideband will thus be twice this, or 50 watts. In this way, we have pushed the capability of the final amplifier up from a useful output of 50 watts peak to 400 watts peak, a factor of 8 times, or approximately 9db. This, then, is the advantage to be gained by using single sideband transmission with a final amplifier of given capabilities.

PRACTICAL ADVANTAGES

The 8-times power advantage that has been predicted by the theoretical considerations above should not be disregarded lightly, simply because they **are** theory. This advantage can be realized in actual practice, so that it is just as real as an actual increase in transmitter power would be, and much less costly. For example, let us consider for a moment the equipment needed to put on the air two signals. One, a conventional 100-watt A.M. transmitter with plate modulation, and the other, an S.S.B. signal of 400 watts peak power. These have already been shown to be obtainable from the same tube or tubes in the final amplifier, so that this, and the power supply to run it, will be identical in both cases. The difference, if any, will be found in the rest of the gear. Another part that will be needed irrespective of which type of signal is to be used, is a stable oscillator, which can be either crystal-controlled, or a V.F.O. In the A.M. transmitter, there will be one or two stages of frequency multiplication, and possibly a small power amplifier to act as driver for the final. If as is most likely, the final uses tetrodes or pentodes, the power amplifier may not be needed. What will be essential, however, is a speech-amplifier and modulator. If we assume that the final in the A.M. transmitter is 70% efficient, the D.C. input to the final will be 143 watts. The A.F. power needed from the modulator will therefore be one-half this, or 71½ watts. Now this amount of audio power not only takes a bit of getting, but is quite costly. In fact, the modulator can be reckoned as the most expensive single item in the transmitter. The power supply for it will, if anything, be as big as that needed for the entire R.F. end of the transmitter, while the modulation transformer is a large and costly item that has no counterpart in the R.F. end.

Now consider the S.S.B. transmitter. The gear needed to generate the single sideband may use up to a dozen valves; these will, however, all be small receiving types irrespective of the exact method used, and there will be no large or very costly components associated with them, particularly if the phasing method of generating the signal is used. The power supply needed for all these tubes will not have to be larger than that of a reasonably-sized broadcast receiver, and certainly much smaller than that needed for a high-quality audio amplifier capable of ten watts output. The single sideband signal will then be obtained, at the desired output frequency, and must now be amplified to a suitable power level. One characteristic of an S.S.B. signal that has so far received no mention is that once it has been made, it cannot be amplified in a Class C amplifier. If any attempt is made to do so, the single sideband becomes badly distorted, and in the process generates a host of new frequencies which spread all over the band in the vicinity of the signal, so that all the advantage of a single sideband is lost. What this boils down to is that single sideband signals must be amplified in linear amplifiers. This means that any R.F. amplifiers used to step up the power of an S.S.B. signal must be be either Class A, Class AB, or Class B stages. Thus,

when a power of a few watts is wanted, with which to drive a final amplifier, the easiest way to get it is to use a small Class A amplifier. This can use the same tubes and power supply that would be used to make an audio amplifier of the same power output. For example, a pair of KT66s, such as are so popular for 15-watt audio amplifiers, can be used with exactly the same power supply and grid bias to produce 15 watts of single sideband R.F. Between 5 and 10 watts is ample to drive most final amplifiers in use today, and remember, if you want to stop there and put this "small" signal on the air, it will be equivalent to a conventional A.M. transmitter with a carrier power of from 40 to 80 watts! At this point one might well wonder whether that final is really necessary! Consider the same pair of KT66s, and their power supply that are in your own Williamson amplifier. You can use the power supply, and the tubes, in a Class A R.F. amplifier. This will take no power to drive it at all, because the grids need only volts, being Class A, and the output will give as much potential communication as a complete A.M. transmitter with a carrier power of 120 watts. Even if you have to build from scratch, power supply and all, just work out roughly the cost of doing it as against the cost of the 120-watt A.M. transmitter, and see whether or not S.S.B. is worth while! Alternatively, if you have just recently started in the amateur transmitting game, and have been boxing along with 20 or 30 watts of C.W., pending building a larger 'phone rig, give a little consideration to the fact that for something like the cost of building a 10-watt audio amplifier, you can have a complete S.S.B. transmitter equivalent to a conventional 50 to 80 watt transmitter, and think which can give the better value. In this value can also be reckoned the joys of learning something new in the radio game that few seasoned amateurs have tackled, largely because of their already heavy investment in conventional transmitting gear, and the thrills to be obtained by pioneering the new form of amateur transmission.

Also, when reckoning the cost of some of the special equipment needed for generating the S.S.B. signal, it should be thought of alongside the cost of building a hulking great modulator that you would have needed for the A.M. rig. Something like a true perspective on costs can then be obtained, even if, for example, you spend several pounds buying special pot cores to make sideband filters with. Even doing S.S.B. the most expensive way, the cost will be much lower than that of an A.M. transmitter with the same capability. Moreover, if you want to start with a relatively low power output, and step it up after gaining some experience with S.S.B., this will be possible at a much lower cost than if you were doing the same thing with A.M., because the complicated portion of the gear, which generates the S.S.B. signal at a low power level, can be used unaltered.

RECEIVING S.S.B.

This short article can by no means be said to have covered the subject at all fully. We have not touched on the receiving aspect, nor have we said anything about how it is accomplished. However, all that will be kept for future articles, and in the meantime, we will be very pleased if this one succeeds in interesting in the subject a few amateurs who were not so interested before.

N.Z.A.R.T. NOTES

(Supplied by the Publicity Committee, N.Z.A.R.T., P.O. Box 1733, Christchurch, to whom all inquiries should be addressed).

In accordance with the policy of many overseas societies, N.Z.A.R.T. is proceeding with the allocation of Listener Numbers to the non-transmitting members of the Association. These numbers will be allocated on application to the General Secretary, and should greatly assist those Listener Members who use the Association's QSL Bureau at Box 489, Wellington. Furthermore, it will enable the member to arrange the printing of his report cards with an "official" number if he so desires.

The Post and Telegraph Department has been approached in an endeavour to secure a Novice Licence for those interested in the hobby. It is hoped that this request will be granted, though at present there is nothing definite to report. Of course, the circumstances under which such licence would be granted and the standard required by the Department are still matters of conjecture.

The possibility of the institution of an A1 Operators' Club by the N.Z.A.R.T. is being investigated also, and inquiries are being made about the administration of a similar award under the A.R.R.L. Such an award in New Zealand could do much to improve the overall operating standard in this country, for no doubt there would be considerable rivalry among would-be applicants for membership of the Club.

August saw the thirtieth birthday of the N.Z.A.R.T. magazine "Break-In", and the occasion was marked by the publication therein of a good deal of old time radio material, including a facsimile of the original issue of the journal. Although the jargon was a little strange to many of the new amateurs, nevertheless it provided a picture of the beginnings of the magazine and the type of chat which was the life blood of those to whom the Association owes it present status and strength. The reproduction of one of the early transmitting stations of Mr. Dave Buchanan at Ashburton was really typical of the class of equipment in vogue in the early days, and it is unfortunate that there are not more photographs and similar material available to depict a really good cross section of the times.

At present the Publicity Committee is preparing a short history of the Association, and would be pleased to receive any data, no matter how insignificant, relating to the early days of radio transmitting in the Dominion. If necessary, summaries will be made of any material provided, and the latter will be returned to the persons concerned, as it is realized that many set great store by relics (if we may be pardoned the use of the word) of the old days.

Recently the Christchurch branch held a function to farewell the Senior Radio Inspector, Mr. E. Pratt, ZL3GB. Ted has earned the friendship and respect of the Christchurch fraternity, and the latter's loss will certainly be Auckland's gain. Members of the Publicity Committee who have been in direct touch with him on many occasions, also extend their heartiest congratulations to him on his new appointment.

In Northland, a class organized by the local branch for Hams-to-be, brought the hobby to a few more. The excellent tuition offered resulted in complete passes on the theory side and three in the morse section of the examination. Since then, all partial passes have made the morse test. The highest mark gained was 97%. Congratulations, Northland, on a really fine effort. In the near future, this Branch proposes to hold another class, and all interested would be well advised to communicate with the Secretary of the Branch, c/o 2 Wolfe Street, Whangarei, for further information.

CHANGE OF ADDRESS

When you change your address, be sure to notify the Subscription Department, "Radio and Electrical Review," P.O. Box 8022, Wellington, New Zealand, and do this at least four weeks in advance. To avoid disappointment through not receiving your copy of "Radio and Electrical Review," should it go to the wrong address through your failure to notify us of a change, we earnestly ask for your co-operation in this important matter.

NOTES ABOUT NEW BOOKS

TIME-SAVING NETWORK CALCULATIONS

By Harry Stockman, S.D. Published by S.E.R. Co., 543 Lexington St., Waltham, Mass., U.S.A. Price $1.75.

In this publication a set of general rules is formulated for the average type of network problem. A discussion of the equation-system solution of network problems, with and without determinants, is carried out, and a comparison made with the voltage and current Potentiometer methods. These methods are applied not only to steady-state, but also to transient conditions, and it is indicated how Laplace Transform solutions gain in brevity and clarity by the proper use of the Potentiometer method, whenever applicable. Additional application examples have been chosen in the fields of input and output immittances. As a further illustration of the usefulness of the Potentiometer concept, it is shown how the output impedance Z_{AB} may be calculated from the complex transfer function A (ω).

Over 250 selected literature references have been included to further aid the reader in his study of time-saving network calculations.

TELEVISION ENGINEERING

Principles of Practice, Vol. II. Video-Frequency Amplification, by S. W. Amos, B.Sc. (Hon.), A.M.I.E.E., and D. C. Birkinshaw, M.B.E., M.A., M.I.E.E. Published by arrangement with the B.B.C. for "Wireless World" by Iliffe and Sons Ltd., Dorset House, Stamford Street, London. S.E.1. Price 35s. (Postage 1s. 2d.).

This is the second volume of a text book on television engineering written by members of the B.B.C. Engineering Division, primarily for the instruction of the Corporation's own staff. The work is intended to provide a comprehensive survey of modern television principles and practice.

This volume describes the fundamental principles of video-frequency amplifiers and examines the factors which limit their performance at the extremes of the passband. A wide variety of circuits is described and particular attention is paid to the use of feedback. There is a section dealing with the special problems of camera-head amplifiers.

Because of the nature of the subject, the text is necessarily more mathematical than that of Vol. I, but whenever possible, self-contained mathematical derivations have been included as appendices at the ends of chapters.

Vol. I of this book deals with fundamental television principles, camera tubes, television optics and electron optics. Vols. III and IV are now in the course of preparation. Vol. III will deal with waveform generation and Vol. IV with a wide range of circuit techniques. These volumes will complete the work.

WIRELESS SERVICING MANUAL

By W. T. Cocking, M.I.E.E. 9th Edtn. Published for "Wireless World" by Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.I. Price 17s. 6d. (Postage 1s.).

This is the ninth edition of a book, which, since 1936, has been known to radio servicemen everywhere as a reliable, thorough and comprehensive guide to solving most of the problems arising in the repair, maintenance and adjustment of the modern receiver. It has been carefully revised to take account of all recent developments in receiving equipment, and this edition appears in a larger and handier format, while all illustrations have been modernized and brought into line with current symbolism.

The book gives much useful advice on the techniques of testing and on interpreting meter readings, and then goes on to examine the troubles that can develop in each individual stage of a set. Both the "straight" and superheterodyne types are covered, and special attention is given to short-wave sets. Full attention is also paid to the question of ganging, and to such common problems as hum distortion and instability.

Current features of design dealt with include automatic frequency control, push-pull amplifiers and negative feedback, while this edition contains a completely new chapter on the servicing of frequency modulated v.h.f. receivers—a development of the greatest importance to all servicemen. There is also valuable information on aerial-earth systems, the use of cathode-ray test gear, and the fitting of extension loudspeakers.

As a frequent contributor to "Wireless World", W. T. Cocking is widely known as an authority on modern radio engineering, and his crisp, lucid style makes this classic handbook of the utmost value to professionals and amateurs alike.

ABACS OR NOMOGRAMS

By A. Giet. Translated from the French by H. D. Phippen and J. W. Head. Published by Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.I. Price 35s. (Postage 10d.).

Most engineers have made use of nomograms at some time in their careers, and are fully alive to the fact that they are a very convenient tool when the same formula has to be solved repeatedly for several sets of variables. It is fair to say, however, that only a small proportion of even those who habitually employ nomograms know how to construct them for their own use. Most of the comparatively small literature on the subject is written for mathematicians and is extremely difficult for the practical engineer to comprehend. The present work, which is the translation of a book which has enjoyed considerable success in France, does not suffer from this defect. It is essentially practical, and not only demonstrates the many and varied applications of the abac or nomogram, but shows how even those without highly specialized mathematical knowledge may construct their own charts. It deals with both Cartesian abacs and alignment charts, and contains a large number of practical examples drawn from the fields of mechanics, physics and electrical engineering. Very few formulae are outside the scope of nomograms if skilfully chosen auxiliary variables are introduced.

This edition, which has been specially adapted for English readers, will prove of the greatest practical interest to engineers and physicists, and many others who require timesaving methods when performing repetitive and complicated calculations.

Miss Helen Phippen, who was responsible for translating M. Giet's book from the French, is a Senior Research Assistant at the Science Museum, South Kensington, and the editor, Mr. J. W. Head, is mathematical consultant to the Research Department of the British Broadcasting Corporation.

SPECIALISTS IN A
SPECIALIZED FIELD.
MR. SERVICEMAN.
Our Universal Coils, types 40 (Aer), 45 (R.F.) and 41 (Osc) will replace any damaged R.F. Coil.
Inductance Specialists
THE N.Z. HIGH FREQUENCY SPECIALISTS
293 THORNDON QUAY, WELLINGTON, N.Z.
COILS, I.F. TRANSFORMERS H.F. CHOKES, B.F.O.'s DIALS, SCALES, COIL ASSEMBLIES, GANGS, BUILT-UP UNITS, ETC.

RADIO SERVICING

Correspondence Course specially compiled to meet New Zealand Examination Syllabus. Free prospectus.

NEW ZEALAND RADIO COLLEGE

26 HELLABY'S BUILDING - - - AUCKLAND, C.1

RECORD TALK

by JOHN GRAY

By now New Zealand has upwards of half a dozen record companies or agencies, all making frequent issues of great quantities of discs in a manner to bewilder the average buyer completely. Those of us "in the know" often wonder how the ordinary customer really does find out just what is available, for until now there has been no central source to give complete information. This is why I am pleased to mention the Record Publishing Co., P.O. Box 175, Christchurch. In a circular letter they announce production of "The Record Monthly", a new magazine which they claim will list "all records released in New Zealand each month". Taking this at its face value, it should prove of inestimable worth. You may obtain the new magazine through your regular dealer at 1s. 6d. per copy or, alternatively, ensure a year's individual supply by sending 18s. to the address quoted.

New popular releases continue in the accepted strain of today: Tanza's Stardusters have seized material from Flotow's opera "Martha" to make an offering which they call "Mostly Martha" and which shares Z276 with the current favourite "No not Much". The Walker-Wolfgramme combination are up to the mark with their latest "island" offerings; "Minoi Minoi" and "South Sea Rose" on Z279 and "Lovely Hula Girl" which is on Z283 backed by "Vana Vana". A number of popular South African songs have been done by the Stardusters, who make a good start with "Sari Marais" and "The Trek Song" on Z292, a record I am anxious to hear, having long sustained the impression that these were alternative titles for one and the same tune.

Festival releases continue to pour forth in three speeds. Their Coral and Decca series from America features such popular stars as Ella Fitzgerald, Don Cornell. Lawrence Welk and Russ Morgan, and there is also a souvenir of Mabel Scott, who scored a big hit when she visited us with the Harlem Blackbirds early this year. On FS879 are "actual performance" recordings of "Mabel's Blues" and "Boogie Woogie Santa Claus", done during the show's Australian run, with Les Welch and his Orchestra in support. Also from Australia, and in a very different vein, is a souvenir of a recent visit there by one of their greatest dramatic actresses, Judith Anderson, who has for long been a very celebrated star of both stage and screen in America. She returned to Sydney last year to star in a special production of the "Medea" of Euripides, and Festival have released excerpts on a twelve-inch disc (CFR12-649) on which this blood-curdling drama comes to life in a way that makes us long to have seen Miss Anderson on the stage. It is an altogether distinguished addition to the growing list of dramatic material on LP.

Back we come to our own time for more "show business" material, with a fresh release of Ethel Merman's record-breaking "Annie Get Your Gun" LP (FR12-926): this is the old "Original cast" recording and all Ethel Merman's admirers will not be long in snapping it up, while those who had the original pressing may well have worn it out by now. Another attraction is the famous Ethel Merman-Mary Martin "duet", a transcript of that fabulous occasion two or three years ago when the Ford Company, looking around for something special to put into their fiftieth anniversary television show, managed to combine, for the first and perhaps the only time, the explosive talents of America's two leading ladies of show business. In less than fifteen minutes the two stars manage to get through twice as many songs, with dazzling effect. On the reverse side of this ten-inch LP (FR10-966) each of them is heard in something from her own repertoire; Mary obliges with the haunting "Mountain High, Valley Low", and Ethel really lets fly with "Eadie was a Lady".

There is less in the classical line from Festival these days, and indeed this sphere is really adequately covered by the rival companies, but two late releases are certainly deserving of notice. One, on Westminster WL5208, is a boiling-down of that company's "Tosca" recording, to fill a very satisfying disc of "highlights". The other, on Vox APL7160, is a worthwhile and "commercial" (in the best sense of the word) issue of the three best known Beethoven piano sonatas, all economically combined on the one disc. There is nothing inferior about these performances either, for the young pianist Orazio Frugoni brings both freshness and authority to his readings. As you might guess, the sonatas are the "Moonlight", "Pathetique", and "Appassionata", and this is the only release which gives them all on the one record.

In the Cetra 45 series are capsule samples from "The Marriage of Figaro" (EPO-0311) featuring the fine Italian soprano Gabriella Gatti, and some of the romantic and tender numbers from Donizetti's "Elixir of Love" are very well sung by Alda Noni and Cesare Valletti on EPO-0316. There is an interesting recital on EPO-0318, by the baritone Guiseppe Valdengo, famous as a leading light in many of Toscanini's opera broadcasts, and more recently famous for having created a temperamental scene during an open-air opera festival in Southern Europe, where he chose to express disagreement with the management over the matter of his fee, by voicing unseemly complaints when he was really supposed to be expressing the woes of Orpheus in Monteverdi's opera. When he made this little Cetra disc, however, he was certainly on his best behaviour vocally, and offers a worthwhile collection of arias, two by Mozart, and one each from Rossini's "William Tell" and Giordano's "Andrea Chenier".

Philips are producing less new material than formerly, but a consolidated list of their previous LP releases provides impressive evidence of a magnificent catalogue. In the sphere of popular "singles" we note the bright and breezy "Vino Vino" which was sung in the "Rose Tattoo" film. It is done on P15508 by a versatile singer, John Paris, who backs it with a new version of "Scotland the Brave", dressed up with the title "My Bonnie Lassie". A newcomer to the list of light ensembles is the Stradivariety Orchestra, a large group from Belgium which will specialise in symphonic style arrangements. This kind of orchestra has a strong following among the huge middlebrow audience, who will be keen to sample the first disc, P 19254. The numbers are "Fur Elise" and "Simplement". The stirring tune "Robin Hood" has been around for some time now, but its popularity is likely to continue and we note that the impressionable juvenile market is turning to long bows and lincoln green as a change from Davy Crockett headgear. At any rate, the latest "Robin Hood" comes from Pete Hanley and it shares B23521 with a cowboy number called "Ridin' Herd". The De John Sisters, on B23502, are busy catching up with the latest revival craze with a number entitled "I'm Learning the Charleston" and are in less vigorous mood with that haunting hit parader, "The Tender Trap".

A small LP list from Philips contains some exceptionally interesting material, highlighted by Sir Thomas Beecham's record (ABR4045) of the quite extraordinary incidental music Sibelius wrote for Shakespeare's "Tempest". This was composed in the mid ninteen twenties and was practically Sibelius's last work before he sought refuge in silence, for the ninety-year-old composer has published virtually nothing since those days. Those who remember the fragments included by Sir Thomas in the HMV Sibelius Society series will be interested to know that the new record contains many numbers not then included. I would draw particular attention to the Storm sequence, which is the only piece of music bearing that name which instantly causes me to think of a storm, not an orchestra trying to imitate one. Then there are the brief but splendidly evocative pieces dealing with such characters as Prospero, Miranda and Caliban; and the passage depicting Ariel's imprisonment in the oak tree, as threatened by Prospero, really does seem to go on for years, not just a couple of minutes. After all this originality there is something almost conventional about Khachaturian's glittering piano concerto, which is usefully accommodated on a ten-inch disc and played by Yuri Boukoff and the Hague Orchestra under Willem van Otterloo (ABR4039). It is not hard to understand the popularity of this concerto, which combines genuine melody with suitably up to date and colourful orchestration.

New Zealand pianist Jack Thompson has come up with two discs which are among the best made domestically by HMV. I could well believe that record HR67, for instance, containing scintillating performances of "Dardanella" and "Chicago", had been made by a famous overseas recording star. The playing is matched by really worthy recording: HMV do not always manage to achieve such a happy combination and have every right to be proud of this record. Scarcely less well made is another grouping, on HR68, of "La Mer", "Over the Rainbow", and "They Didn't Believe Me". Popular material from overseas is quite dominated by the first Elvis Presley disc, "Heartbreak Hotel" and "I Was the One". (HMV HR10268). It is the sort of record which makes the poor commentator feel quite helpless. One's instincts cry out that the whole thing is rubbish, the

singer's voice and style frightful, the record an insult to intelligence. Then we read about the million odd copies sold in the United States, the craze which has bumped Mr. Presley up to the dizziest heights ever attained by Frank Sinatra or Johnnie Ray, the fortune which has changed him from the boy with the guitar to the boy with two Cadillacs (one for himself the other for the guitar). The public must always have something or someone new, and sooner or later it will find something even more appalling than Mr. Elvis Presley. Only the one disc has been issued at the time of writing, but there will doubtless be many more. Back we go to calm waters with the latest Les Paul-Mary Ford offering "Magic Melody" and "Amukiriki" (Capitol 3248) and to Nelson Riddle's haunting "Port au Prince" (3374). We also welcome an old friend in Vaughn Monroe, who makes his reappearance on HR10210 with "Don't Go to Strangers" and "Steel Guitar Rag", and can nod indulgently towards the latest racket from Boyd Bennett and his Rockets, "Right Around the Corner" and "Partners for Life", which may be had on NZP37, and an even more recent coupling, "Blue Suede Shoes" and "Mumble Blues", released on NZP41. The best tune of recent weeks, however, is Rodgers and Hammerstein's "No Other Love", from their show "Me and Juliet", which was also used instrumentally by Richard Rodgers in his "Victory at Sea" music. It will doubtless be featured on many records before very long and is meanwhile well done by Ronnie Hilton on HR10254, backed by "It's All Been Done Before."

Long playing releases from HMV and their affiliates present us with the usual problem of quantity: how can one do justice to such a vast number in the limited space available? There is a most likeable collection of Folk Songs and Ballads on HMV CLPC11. Now folk song records have been coming forth in an unending flood and their interest, in the long run, is inclined to be limited: but there is something about this new singer William Clausson, which immediately revives one's interest. He sings with guitar and is supported in some numbers by a vocal group. The disc carries a good mixture of the unexpected and the unfamiliar, and the treatment is definitely superior. Interest is further heightened by a rumour that the singer may be visiting us next year. Also in the entertainment sphere from HMV is another Spike Jones LP (ODLP7503) which is accurately entitled "A Course in Musical Depreciation" and races us once again through the William Tell Overture, besides casting highly irreverent glances at "That Old Black Magic" and "Love in Bloom".

If you can bear the thought of another Brahms violin concerto you will be more than interested in the fact that the latest soloist is Heifetz. Fortunate indeed are those who have so far refrained from investing in this concerto on LP, for the great (some would still say the greatest) violinist gives the performance of one's dreams and is himself given the just benefit of first class support from Fritz Reiner and the Chicago Symphony Orchestra and first class recording from HMV (ALP1334). There is more Beethoven from Furtwanger, in the shape of the bright but none the less imposing first symphony, of which the great conductor took what may seem, to some, a rather serious view (ALP1324). But the disc is rounded off by the longest and in some ways the most interesting of the "Leonora" overtures, the second, the basic material of which was, later, compressed to make the more familiar No. 3. This is a weighty, impressive performance by the Berlin Philharmonic (the symphony, on the other hand, is played by the Vienna Philharmonic). HMV now have Furtwangler performances of all the Beethoven symphonies except the second and eighth; I hope that the conductor had completed these before his untimely death because his Beethoven readings were almost legendary and none the less valuable for being, sometimes, drastically different from those of other fashionable conductors. There is more Beethoven from Columbia, a beautiful rendering of the fourth piano concerto, by Claudio Arrau with the Philharmonia Orchestra under Alceo Galliera (33CX1333).

Of late there have been some fine recordings of "Scheherazade", which outside Tchaikovsky, is the best loved of the large-scale Russian orchestral works. Owners of modern LP versions, whose acquaintance with the work goes back some years, will doubtless recall the excitement aroused by the old Stokowski recordings with the Philadelphia Orchestra, first on black label HMV in the earliest days of electrical recording, and later on red label, in the mid 1930s. They may have yearned for an up to date Stokowski version and, sure enough, it has now arrived. It is the famous maestro's first, and so far only recording made with an English orchestra (the Philharmonia) and is released on ALP1339. The sound is of couse wonderful, the playing superb, but the conductor is as prone as ever to pulling and pushing the music about in accordance with his ideas of "expression", and a more straightforward account is to be had from Ansermet on Decca. A very noticeable gap in the LP repertoire has just been filled by the release of the Brahms "German Requiem" on three sides (ALP1351-2), in a performance recorded just over a year ago in Berlin. The St. Hedwig's Cathedral Choir and the Philharmonic Orchestra of that city are conducted by HMV's new "find", Rudolf Kempe (now a regular guest conductor at Covent Garden) in an interpretation which should easily withstand challenges from other quarters. The soloists are Elisabeth Grummer and Dietrich Fischer-Dieskau, and this is, like the Brahms violin concerto mentioned above, one of those releases which can be hailed unreservedly, as a complete success from every angle. The devotee of Brahms has indeed been well served by these two issues.

MISSING AND STOLEN RADIOS

Auckland:

Skyscrapper car radio, serial No. 158508; dial, volume, and tuning knobs brown with green and black paint on side. Piece of dial missing.

Pye 5-valve console model, serial No. 71746. Light oak cabinet 32 in. x 34 in. x 16 in., with two half-depth doors on front which conceal radio and Monarch 3-speed multi-record player with BSR on white plastic badge. Speaker below doors is covered by two wooden louvres.

Tauranga:

Mullard model 655 portable radio, serial No. 75693. Brownish-maroon bakelite cabinet 10 in. x 8 in. x 4 in. with plastic carrying handle at top centre, oblong dial top front and four control knobs of clear glass in sets of two at bottom.

Philco Model 501, "Inter-com" radio, serial No. 50375. Brown bakelite cabinet 18 in. x 10 in. x 8 in. with oblong dial at front top, grille type speaker at front centre, five control knobs set at even spaces along front bottom.

Opotiki:

Stewart Warner 1935 or 1936 5-valve mantel model in dark oak rectangular cabinet with rounded corners, round dial with speaker on left and three knobs.

Paeroa:

Columbus 5-valve broadcast, mantel model 565, serial No. 53017. Burgundy plastic cabinet with 4 plastic strips across front with stations marked thereon.

Ngongotaha:

Autocrat 8-valve, push-button car radio, serial No. 24870.

Foxton:

Ultimate 5-valve broadcast radio in cream bakelite case.

Wellington:

Autocrat manual tuned, universal, 6-volt, 8-valve car radio, serial No. 21682 (minus speaker unit). Brown cabinet 8 in. x 8 in. x 2 in. with serial No. on metal plate at back of radio.

Pye model "R", 230 volt, 4-valve portable radiogram, serial No. 63392. Light brown rexine cabinet.

Philips 5-valve mantel model, No. 1/456, serial No. 89044. Brown bakelite cabinet 15 in. x 10 in. x 7 in.

Lower Hutt:

Pacemaker 5-valve AC/DC portable radio, serial No. 54354; ivory plastic cabinet.

Christchurch:

Autocrat 8-valve car radio, serial No. 28635. Brown cabinet with two white tuning controls situated either side of dial which is 12 in. x 6 in. Cabinet chipped by gear lever close to tuning knob.

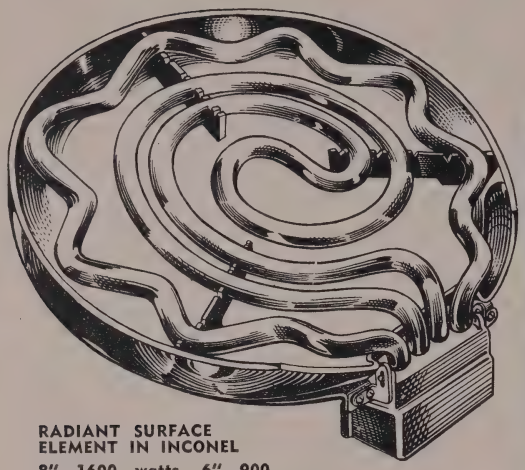
Philco, model 401, grey mantel radio, serial No. 72859.

Autocrat 6-volt, 8-valve car radio, serial No. 30682; blue enamel finish with brown push buttons and tuning knobs.

Ford battery model car radio with brown vibrator box which fits below dashboard. Speaker was fitted into hood of car.

When there's a better switch
ARCOLECTRIC will make it
New Zealand Agents
GREEN & COOPER LTD. WELLINGTON.

Industry turns on the heat with



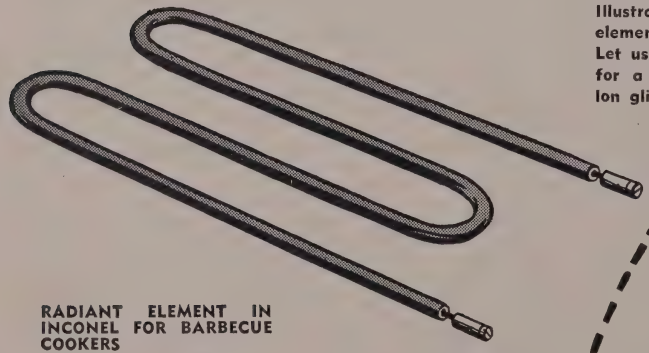
RADIANT SURFACE ELEMENT IN INCONEL
8" 1600 watts, 6" 900 watts.

EUTRON

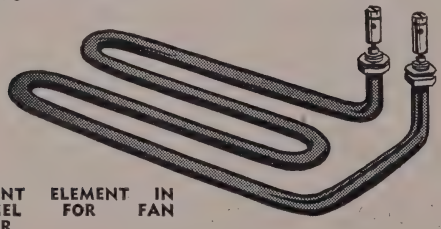
TUBULAR HEATERS FOR ALL PURPOSES

Eutron can manufacture to your design, tubular elements in metals suitable for your particular application.

Illustrations are typical examples of the many types of elements we are making for New Zealand manufacturers. Let us have your enquiry and we will design and quote you for a suitable element with guaranteed dependability and lon glife.



RADIANT ELEMENT IN INCONEL FOR BARBECUE COOKERS



RADIANT ELEMENT IN INCONEL FOR FAN HEATER

AIR HEATING
OIL HEATING
RANGE HEATING
WATER HEATING
INFRA-RED HEATING

ELECTRIC UTILITIES CO. LTD.

3 College Hill, Auckland. Phone: 42-134

ELECTRICAL AND TRADE SECTION

TAKE A LITTLE TROUBLE—WIN A LOT OF SALES

(Reprinted from Pye "Hi-Fi News", Spring, 1956)

In the United States a big Hi Fi boom is on, and dealers are reaping rich rewards. This condensation of an article in the "American Exporter" tells how they do it over there.

With the American high-fidelity business booming along at a $100,000,000-a-year level, expectations in many quarters are that it can grow quickly into a $300,000,000 industry. One factor behind this rapid growth is the improved understanding of effective high-fidelity merchandising techniques. Many American dealers believe that selling high-fidelity differs sharply from selling standard radios and gramophones. The most successful dealers "sell" not the components, but the music reproduced by the system. They dramatize not what high-fidelity is, but what it does.

To accomplish this kind of selling most effectively, most American dealers have set up a special demonstrating or "listening" room. It sets the stage for high-fidelify performance. This room is, first of all, to some extent treated for better sound so that the equipment shows off to best advantage.

The room is also comfortably and attractively furnished to make it easy to enjoy good music. In order to establish a home-like atmosphere, many shops serve coffee, or even cocktails, during demonstrations. This room should be accessible to store traffic.

Though some dealers have several demonstration rooms, one is sufficient. (A good salesman can demonstrate and address his explanations to several customers at once.) The size of the room varies from dealer to dealer, depending on space available. About 15 x 30 ft. is desirable, but even 15 x 15 ft. is practical where space is at a premium. A 10-foot ceiling height or better is advised, though many dealers have effective rooms with lower ceilings.

Lighting is important, both from the point of view of comfort and of showing off the equipment. Small ceiling spotlights, for instance, can dramatically highlight certain pieces without glaring in the eyes of the customer. If the lights are too bright, the equipment's small defects in painting, etc., show up. On the other hand, it must be bright enough for people reading catalogues and other product information. Valances installed around the side of the room will diffuse light.

ACOUSTICAL PROBLEMS

Most rooms, of whatever size, present acoustical problems of one sort or another. The quality of the music may be reduced by sound absorption, reverberation against walls, or amplifying with bare floors. However, these problems can be solved without too much trouble or expense.

Many dealers put their speakers in a corner, which serves as a "baffle" for the music. Walls without covering should be on both sides of the speaker to help give forward "bounce" to the music. If they are placed in a corner beside two windows, a soft drape of loosely woven fabric is all right, and won't absorb high frequency.

Speakers should face a "dead" wall across the room as well as being flanked by two "live" ones in the corner. The dead wall should be draped with a closely woven fabric or have acoustic tiles. It will then absorb sound as soon as the sound reaches this farthest wall in the room. This will prevent sound from bouncing back and reaching the listener's ear several microseconds after the first time he heard it. Split-second reverberation causes distortion of the music in the ear of the listener.

In placing furniture, chairs should be equi-distant from speakers for purposes of fair comparison. This is one reason that sometimes a small room is better than a big one.

Acoustical treatment of a room has one disadvantage. It makes for still-non-circulating air. Since opening a window would interfere with the "sound-conditioning," it is very important to air-condition the sound room. It is difficult to sell anything to an over-heated customer.

In displaying the equipment, open shelves have been found most satisfactory. They give the customer an opportunity to see, examine, and operate all the units. It is best not to crowd too much equipment together, so that the customer can visualize the units in his own home.

It is recommended that tuners, record players, tape recorders, pre-amplifiers and amplifiers, loudspeakers in their proper baffles, etc., be grouped separately for ready comparison of features, appearance, operation, and price.

The high-fidelity showroom can profitably contain some testing instruments to show off the products. Some dealers have installed oscilloscopes to dramatize amplifier operation. Whether the customer technically understands an oscilloscope or not, it is interesting for him to "see" the response of the units being tested. A power level meter can make the same kind of visual impression.

HOW TO USE THE SHOWROOM

One of the most important elements of a high-fidelity demonstration is the programme source. If records are used, there should be an adequate cabinet in which to protect them from dust and scratches. A marred record can appreciably lower the quality of sound reproduction and the impact of the demonstration. This cabinet can be installed right under a shelf so as not to take up valuable display space.

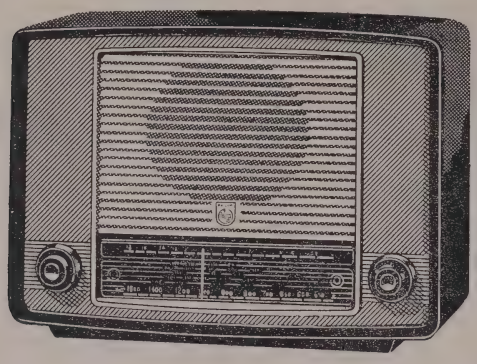
(Continued on page 51)

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. For further particulars contact Advertising Manager, R. & E., Box 8022, Wellington.

A THOUGHT FOR THE FUTURE—PHILIPS "INTERNATIONAL" TV COMPANION

After observing overseas trends, New Zealand broadcasting men are generally agreed that television will not replace radio but will function side by side with it in the home.



This suggests that New Zealand listeners will require radios to match their television sets when a video service begins. The more advanced manufacturers have clearly been thinking ahead to this time so that the listener may buy a radio which will be found to complement the TV set he will buy two or three years from now.

Consequently Philips have produced a television companion mantel receiver which was released last month.

This new dual-wave model has been christened the "International", a name suggested by its universal appeal and by its remarkably fine reception on short-wave.

A glance at the illustration gives some idea of the appealing "squared circle" design. The rectangular grille with horizontal venting accentuates the similarity to a TV set, especially as it is inset and bearing in mind how this shape readily suggests that of a television viewer. The general symmetry, concentric controls and recessed moulding also match the styling of television receivers. A comparison with recent TV models strengthens this sense of matched design.

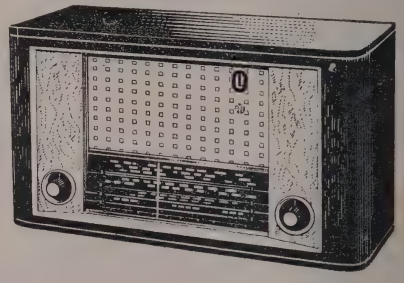
The Philips "International" model 367 is also ahead of its time in technical development. The Ferroceptor internal rod aerial begins a process of improved reception by sharpening sensitivity and selectivity due to its recognised directional charactertistics, yet cutting down interference to a new low. Further along the circuit, Micro 12 band pass filters make it possible to produce greater volume, if required, without distortion.

Early success of the Philips "International" television companion has indicated that buyers are taking advantage of the opportunity to choose for the future whilst enjoying the best of the present.

Confident of its fast movement, the makers of the "International" have set an attractive retail price of £29 8s.

PYE GOLDEN STAR MANTEL—MODEL 202: 7-VALVE, BANDSPREAD

Nothing approaches Pye Model 202 in the radio field. It is really the golden star of home listening with a quality of tone, an accuracy of reproduction



and an extensive range that place it in a class by itself.

The more critical and exacting a listener you are the more fully you will appreciate the high degree of sensitivity and selectivity of this, the acme of perfection in a mantel receiver. Housed elegantly in a dark mahogany veneered cabinet of unusually rich finish but of classically simple design, this golden star Pye 202 contrasts the solid richness of appearance with brilliantly lighted scale panel and control knobs.

Designed to include every technical advance, this mantel model incorporates a 7-valve, 5-waveband chassis, giving the widest range of programmes with full short wave band-spreading thus ensuring the speed, accuracy and certainty of selection which is so typically Pye.

Among its special features is the 8-inch loudspeaker, the quality of which is responsible for the remarkable fidelity of reproduction at all volume levels. Pye 202 has continuously variable tone control, concentric controls for easy manipulation and is fitted with a twin vision tuner.

The simple efficiency of chassis design can be appreciated at a glance, and the confidence in its value is enhanced by consideration of the chassis features of selective negative feedback and the switched pick-up sockets. The whole is fully tropicalized and thereby prepared for any climatic conditions. Priced so very reasonably too at £55 12s. 6d.

Pye Ltd., P.O. Box 2839, Auckland. Branches at 43 Lower Taranaki Street, Wellington, and 16-18 Victoria Street, Christchurch.

SUFLEX POLYSTYRENE CAPACITORS

John Gilbert and Co. Ltd., of Auckland, have pleasure in announcing the introduction of Suflex Polystyrene Capacitors to the New Zealand market.

Polystyrene has four important properties, i.e., low dielectric loss; high insulation resistance; dielectric constant unaffected by voltage, temperature or frequency changes; negligible water absorption.

Suflex Polystyrene Capacitors use polystyrene as the dielectric thus producing capacitors with excellent electrical performance and great resistance to humidity.

The characteristics of Suflex Capacitors are as follows:—

Low Power Factor: Less than .0003.

High Insulation Resistance: Greater than 10^6 megs.

High Capacitance Stability: Changes less than 1% (after humidity test).

Wide Temp. Range: —40°C. to +80°C.

Constant Neg. Temp. Coef.: -120×10^{-6} parts per °C.

High Q at V.H.F.: Low radiation.

Inert Dielectric: Small physical size.

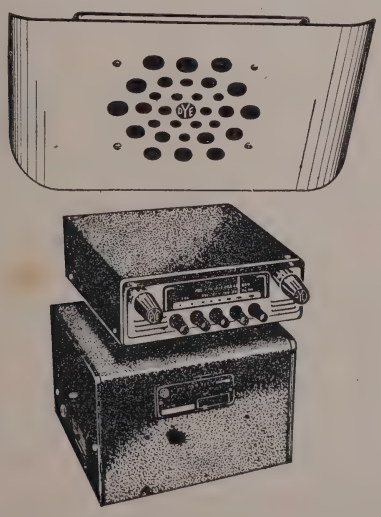
Suflex capacitors are particularly suitable for use in I.F. Transformers, filter circuits, coupling and decoupling at all frequencies, and in computing circuits.

For further information write, call or 'phone John Gilbert & Co. Ltd., Tasman Buildings, Anzac Avenue, Auckland, the sole New Zealand agents for Suflex Ltd., London.

◈——◈

RIGHT ON THE BUTTON—NEW PYE CAR RADIO

With Pye P808/9 there is no need to take your eyes off the road for an instant because the push-button control gives you easy and immediate station selection.



P808/9 is the new push-button 8-valve 3-unit car radio brought out by Pye to meet the need for a set which embodies every modern advancement in radio engineering. P808 is for 6-volt systems and P809 for 12 volt. The independent power pack allows for convenient placement on the forward bulkhead, or wherever it is considered most easily kept out of view. The speaker unit is mounted on a tilting bracket ensuring a flush, and symmetrical installation.

The value of the 5 push-button tuning control is evident to any motorist, and for the man travelling long distances on schedule the fact that he can select any of the pre-tuned stations with a momentary finger pressure, assures full concentration on the actual driving.

The power and tone of this Pye car radio is recognized immediately it is heard because it possesses in full the distinctive Pye features of clarity and sweetness of tone at all levels, combined with the backing power supply, and the tubes, in a Class A R.F. amplifier of unlimited power.

At the low cost of £37 19s. 6d., Pye P808/9 is a striking advance in design and quality in car radios, offered at a price that every car owner can easily afford. Definitely a Pye winner, this P808/9.

Pye Ltd., P.O. Box 2839, Auckland, and branches at 43 Lower Taranaki Street, Wellington, and 16-18 Victoria Street, Christchurch.

– – ◈ – –

THE INTERNATIONAL TELEMETER CORPORATION MNEMOTRON

The International Telemeter Corporation of Los Angeles, California, has completed a large, high-speed magnetic-core memory called the Mnemotron ("memory device"). This is a coincident-current ferrite-core memory with a capacity of 4096 forty-bit words. The 40 bits in each word are read and written in parallel. There is random access to any word with access time of 8 microseconds. A complete memory cycle, including a Read or Write operation takes 15 microseconds.

The 163,840 cores of the memory are arranged in rows and columns of 40 128 x 32 matrices. The matrices are driven in their long dimension by 32 vacuum tube switch drivers and in their short dimension by 40 128-way ferrite core switches. The circuits of the memory contain 1207 electron tubes. During an acceptance test consisting of 72 accrued hours of intermittent operation, the memory made no random errors. Throughout the first four weeks of actual computing, the Mnemotron made only two mistakes.

—◈—

15-INCH PERMANENT MAGNET LOUDSPEAKERS

A recent addition to the Plessey range of loudspeakers is a general purpose 15 in. permanent magnet unit suitable for use in cinema and public address installations or as the bass reproducer in dual loudspeaker systems, in which full use can be made of its low fundamental resonance and smooth response.

This loudspeaker is notable for its robust construction and the elaborate precautions which have been taken to ensure consistent results under the most adverse climatic conditions.

The chassis, which is cast in aluminium to give great mechanical stability and is finished in an attractive crackle black enamel, holds a felted cone driven by a 2-inch speech coil. This is wound on an aluminium former and protected against atmospheric action by a baked varnish impregnation. Additional protection is given by the outside suspension and moulded speech-coil dome, which excludes all dust.

The coil moves in a gap having a field strength of 15,000 gauss, energised by a permanent magnet giving a total flux of 228,000 lines. The bass resonance can be arranged to occur at any frequency between 30 and 60 c.p.s. to suit individual requirements, while the useful high frequency response extends to 8 Kc/s.

The speaker can also be supplied, at slight extra cost, with a velour surround to the cone in place of the paper corrugations. This results in reducing the resonance to 25 c.p.s. and a somewhat smoother response characteristic.

ELECTRICAL APPLIANCES OF THE FUTURE

At the recent British Electrical Power Convention, Mr Denis Bellamy, O.B.E., Chairman of the Yorkshire Electricity Board and Chairman of the British Electrical Development Association, gave an interesting outline of some of the electrical appliances which may appear in the future.

Though his remarks referred chiefly to possible developments in Great Britain, they are not without interest to New Zealand, where one enterprising firm at least has introduced a cooker with oven separate from the hob, and no doubt manufacturers will be quick to adopt some of the new ideas in other fields when market conditions appear favourable.

ELECTROSTATIC DUST REMOVAL

The cloth duster might well be superseded by the suction cleaner, contended Mr. Bellamy, pointing out that future developments of the latter could lead to electrostatic dust removal. Alternatively, a wider use of air-conditioning and cleaning, possibly by electrostatic methods, might reduce the presence of dust in the domestic atmosphere.

SEPARATE OVENS

In the roomier kitchens of new houses in the United States, there was increasingly a separation of the hob-function from that of the oven. A shallow unit carrying three or four radiant plates was carried at waist height on unit service cupboards, with the large, automatically timed oven alongside at the same height. Though this development was not new to Britain, and had much to recommend it compared with both the traditional type of cooker and the more recent high-level oven cooker, unfortunately, due to the small size of the majority of kitchens in Britain, it had only limited application.

COOKER DEVELOPMENTS

According to Mr. Bellamy, removable aluminium oven liners which could be replaced in a few moments might ease the cooker-cleaning problem considerably. Also, there might be development of a very direct thermostatic cooking control. An adjustable thermostatic skewer was just being developed which could be left in a joint to give visual or audible indication when the centre of the joint had reached the desired temperature. The device could be used to switch off the current where necessary.

ELECTRONIC OVEN

The electronic oven, perhaps, was a little further in the future. Using high-frequency currents of about 2,400 mc/s., the meal could be cooked completely while the family prepared for dinner. At present, such ovens cost about £400 to £500 in Britain, but no doubt the usual process of technical development and mass production would reduce this price in the future.

DOMESTIC HEATING

In view of the potential fuel-saving, said Mr. Bellamy, it was disappointing that, as yet in Britain, there had been no substantial attempts to provide at least prototype heat pump installations for space heating in any type of premises. In America, the dual-purpose heat pump for summer cooling and winter heating in domestic and other premises was expected to be developed rapidly.

It was estimated that, by 1958, the initial cost of a heat pump would be slightly more than 2,000 dollars in relation to a house cost of 25,000 dollars. In Britain, the approximately comparable costs would be about £500 in a house costing £5,000 to £6,000, and installations in smaller houses would be a greater proportion of total building costs.

Thus, the development of the individual house heat pump was not likely to be an economic proposition in Britain for some considerable time. On the other hand, the development in medium-sized commercial premises would appear to offer possibilities which should be investigated because of potential fuel savings. Then there would be a possible extension to blocks of flats or even to groups of conventional houses which could be used to provide increased heating standards before such time as generation from nuclear energy became unlimited.

THE DEEP FREEZE

Mr. Bellamy considered that the deep freeze, a popular appliance in America, was unlikely to find more than a small market in Britain on account of the relative stability of food prices.

A FURTHER STEP TOWARDS AUTOMATION

An Automatic Telephone Answering Machine: "Robotphone"

An item of particular interest in the Electronic Features Section of this year's Radio Show was the Pye "Robotphone", which is a telephone answering machine designed to answer a telephone automatically in the absence of the subscriber as well as permitting the caller to record a message. The instrument is connected to the Post Office line, but does not affect the normal operation of the associated telephone instrument.

The method by which the "Robotphone" works is as follows: If the subscriber is out when his telephone rings, it will continue to ring for ten seconds, after which the answering machine will automatically connect to the line. A pre-recorded message then gives the subscriber's identity and whereabouts, and invites the caller to record a message which the subscriber can play back when he returns.

The "Robotphone", which measures 34½ in. by 16½ in. wide by 12 in. deep, has been specially designed for use in business premises during off duty hours so that urgent messages can be given, and orders taken at any time of the day or night.

NEW RADIO CENTRE, INDIA

The Government of India has just opened a new international radio centre at Calcutta, an important new link in Commonwealth communications. On the occasion of the opening by Shri Jagjivan Ram, India's Minister of Communications, the Hon. T. P. Shand, Postmaster-General, sent a message of congratulation and good wishes.

AN UNWELCOME SILENCE

Safeguarding the mails takes on a new significance with a problem which arose recently in Britain. As tape recordings are now being posted in considerable quantities by overseas representatives visiting New Zealand business concerns, the same problem may, on occasion, occur here.

Recently a businessman on receiving a magnetic tape recording by air mail was amazed when the playback yielded absolute silence—and the silence was not golden. The magnetic field set up by the generators in the aircraft had completely erased the recording. Wrapping each tape recording carefully in tin foil prevents erasure.

TRADE WINDS

RETIREMENT OF MR. G. ROBERTSON

The A.W.A. Showroom in Anvil House, Wellington, was the scene of a recent cocktail party when members of the radio fraternity gathered to honour Mr. G. Robertson whose retirement from the position of New Zealand Manager for Messrs. Amalgamated Wireless (Australasia) Ltd., took place at the end of July.

Born in Stow, Midlothian, 70 years ago, Mr. Robertson received his education at various public schools in Scotland, finishing at Madras College, St. Andrews.

First entering the service of the British Post Office in 1901 he left to join the Marconi Telegraph Co. Ltd. in 1908, and following the amalgamation of Marconi and Telefunken interests in Australia, he has been in the service of Amalgamated Wireless (Australasia) Ltd., since its formation in 1913.

Leaving Australia with the Main Body in 1914, he eventually returned in June, 1919. Some months later he left for Nukualofa, Tonga, to assist the late Mr. Jock Campbell in the erection of Tonga's first radio station.

Appointed New Zealand Manager for Amalgamated Wireless (Australasia) Ltd., Mr. Robertson came to this country in 1920, and ever since has played a prominent part in the development of radio and electronic interests in the Dominion.

As his services will continue to be available to Amalgamated Wireless (Australasia) Ltd., in a consultative capacity, the industry will not be deprived of the knowledge and advice of one who has rendered such outstanding service during his long association with radio interests, and we join with all his friends in wishing him a long and happy "retirement".

APPOINTMENT OF NEW MANAGER FOR A.W.A. IN NEW ZEALAND

Newly appointed New Zealand manager for Messrs. Amalgamated Wireless (Australasia) Ltd., is Mr. E. E. Pernase, who is no stranger to the trade in this country.

Upon the completion of his formal education, Mr. Pernase entered the Marconi School of Wireless (A.W.A.'s technical training centre), afterwards being engaged on the engineering side of Commercial Broadcasting.

The first two and a half years of World War 11 were spent in the Maritime Service, during which time he visited the Philippine Islands, Hong Kong, Singapore, Java, Ceylon, and India. Following his transfer to flying, he then served in the New Guinea theatre, and while associated with aviation he obtained his Ground Engineer's Certificate for Aircraft Radio and also a Navigator's Licence.

After returning to Amalgamated Wireless (Australasia) Ltd., Sydney, Mr. Pernase was transferred to New Zealand, where, during the past 11 years he has been engaged in the many varied technical projects of the company, amongst which are the installation and maintenance of Aircraft and Marine Communications apparatus, Radar and X-ray.

Mr. E. E. Pernase

In 1954, on behalf of the company, Mr. Pernase visited the U.S.A., U.K., and the Continent, and since that time has been fully engaged on the sales side, from which position he has been promoted to New Zealand Manager of Amalgamated Wireless (Australasia) Ltd.

All members of the radio and communications fraternity join in extending congratulations to Mr. Pernase on his appointment and best wishes for every success in his new undertakings.

NEW ZEALAND OVERSEAS COMMITTEE OF BEAMA FORMED

Throughout the years the British Electrical and Allied Manufacturers' Association (BEAMA), of London, has sponsored the formation of similar committees in their main export markets.

Recently the New Zealand Overseas Committee of BEAMA was constituted, its aims and purposes being:

(a) To promote goodwill in New Zealand for the British electrical manufacturing industry, and to uphold its prestige by ensuring a local understanding of its past achievements, present aims, and future developments.

(b) To advise its members of the special needs and characteristics of the New Zealand market, and the difficulties likely to be encountered from time to time.

(c) To interpret to the United Kingdom manufacturer, New Zealand conditions and outlook, and, conversely, to convey to the New Zealand buyer the problems and outlook of the manufacturers in the United Kingdom.

(d) To take all steps necessary to expand the trade of its members in the New Zealand market.

Chairman of the New Zealand Committee is Mr. W. A. Simpson (A. Reyrolle & Co. Ltd.), Vice-Chairman is Mr. G. R. Owen (British Thomson-

Houston Export Co. Ltd.), and executive members are Messrs. J. H. Lee (Metropolitan-Vickers Electrical Co. Ltd.), S. C. Brown (British General Electric Co. Ltd.), E. G. Butterworth (English Electric Company Ltd.), and C. N. Hayward (N.Z. Industrial Gases Ltd.)

BRITISH GENERAL ELECTRIC NEWS

Mr. P. L. Cowie, B.E., A.M.I.E.E., who has been assistant engineer with the British General Electric Co Ltd., at Wellington, for a little more than three years and has become well known to local engineering circles, was transferred recently to Christchurch as engineer for the company's South Island territory.

After serving in the Navy during the War, Mr. Cowie took his engineering degree at Canterbury University College, followed by a post-graduate course at the Heavy Engineering Works of the General Electric Company Limited of England in Birmingham.

Born in Invercargill, Mr. Cowie is happy to be closer to his "native heath."

GRAHAM REID & CO. LTD. OPENING IN CHRISTCHURCH

The address of the new firm of Graham Reid & Co. Ltd., which has opened in Christchurch recently, is 303 Durham Street. This firm will be a wholesale stockist of radio components and electrical supplies for contractors. It has also secured the Canterbury agency for Enfield cables.

Enterprising manager is David Graham Reid, who has recently returned from England, where he has spent three years with the Marconi Company installing television throughout England and the Continent. Graham is an old boy of the Waitaki Boys' High School, and graduated Bachelor of Engineering, specializing in electronics, at the Canterbury University College.

AMPEX CORPORATION OF U.S.A. APPOINT A.W.A. AS N.Z REPRESENTATIVES

Amalgamated Wireless (Australasia) Limited has been appointed New Zealand representative of the Ampex Corporation, Redwood City, California, U.S.A.

The Ampex Corporation of America has established a leading role in the design, development, and manufacture of magnetic recorders, and Messrs. Amalgamated Wireless (Australasia) Ltd., of P.O. Box 830, Wellington, will be pleased to handle all inquiries for this equipment.

NUFFIELD FELLOWSHIP AWARD TO GEOPHYSICIST

Dr. Frank Evison, geophysicist of the Department of Scientific and Industrial Research (Geophysics Division) has been awarded a Nuffield Fellowship to undertake studies on seismology at Cambridge University.

Dr. F. F. Evison, M.A., B.Sc., Ph.D., D.I.C., received his early education at Christchurch West High School and Wellington College. During the war he was granted a commission in the radar branch of the R.N.Z.A.F. and served for three years. In 1947 he graduated with honours in mathematics at Victoria University College.

From 1945 to 1947, Dr. Evison was a member of the staff of the Dominion Physical Laboratory, D.S.I.R., and later went to England to study at the University of London, where he obtained his doctorate in 1950 for research on the propagation of seismic waves. In the course of this work, he developed an electrical machine for transmitting vibration impulses to the ground, which has since proved valuable as a practical tool as well as an instrument to further scientific research; the vibrator has been used, for example, to find the elasticity of the foundation rock at the Whakamaru dam. Dr. Evison has had a number of papers published in England and the U.S.A. on his work in this field.

On returning to New Zealand, Dr. Evison joined the newly-formed Geophysics Division of the Department, where, as a senior physicist, he initiated an investigation of strata deformation in coal-mines. He has recently been studying resonant vibrations in the foundations of bridges.

In his undergraduate days, Dr. Evison took a keen interest in tramping, ski-ing, and mountaineering. Later, he climbed in the Swiss and Austrian Alps, and in 1949 was elected a member of the Alpine Club (London).

He has taken an active part in the New Zealand Association of Scientists, and is at present chairman of the Wellington Branch.

Dr. Evison will leave for England later this year with his wife and two children to take up the Nuffield Fellowship at Cambridge University, where he intends to study recent advances in seismology.

NZ.E.I. NEWS

On 28th June, the Council of the New Zealand Electronics Institute (Inc.) approved the following transfers within and new admissions to the Institute:

K. D. Adams, 11 Zohrab Street, Wellington, E.2, Associate Member.

R. F. Elsom, 26 Lonsdale Crescent, Wellington, Student to Graduate.

C. E. Price, c/o N.Z.B.S., Gebbies Pass, Christchurch, Graduate.

V. M. Stagpoole, Makara Radio Station, c/o Karori Post Office, Wellington, Associate to Associate Member.

NEW CATALOGUES

Two small, but well known firms in the New Zealand Radio Trade have recently produced catalogues, which we commend for their originality.

We refer to the catalogues produced by—

Messrs. Inductance Specialists of 157 Thorndon Quay, Wellington, and

Messrs. Fred Rothschild & Son, P. O. Box 170, Lower Hutt.

Both have shown that, with careful thought and planning it is possible for small firms to produce inexpensive, but nevertheless comprehensive catalogues, which are procurable from the addresses given above.

NEW PREMISES FOR E.D.A.C.

On September 1, E.D.A.C. moved into new premises at 18-20 Lorne Street, which parallels Courtenay Place between Tory Street and Cambridge Terrace, Wellington.

The new premises are commodious and convenient and provide badly needed room for expansion.

For the first time, E.D.A.C. now has its Development Section, Production Section, Offices, Stores and Administration, housed under one roof.

Although E.D.A.C. has been operating only a short time, its operations are already covering a wide field of activity and many interesting electronic problems are being dealt with each month.

The staff now consists of 20 under Managing Director Ralph Slade, who tells us how pleased he is with the progress made to date. An increasing proportion of the staff is scientifically trained as, of course, must be the case in the electronic field in which E.D.A.C. operates.

One interesting and new E.D.A.C. activity is the provision of an engineering consultive service to Industry, whereby specialized engineers and equipment are made available to investigate certain production problems and to supply results and conclusions to Management for their guidance. This service is at present confined to ascertaining stresses and strains in structures and fabricated components where accurate knowledge of safe loads, etc., is required.

Several interesting problems of this kind have already been dealt with and others of some magnitude are pending. Altogether, E.D.A.C. is a very vigorous child which is growing up rapidly and interestingly.

E.D.A.C. does not, of course, concern itself only with such highly specialized activities. As is already known, it is an increasingly important supplier to Radio factories of all kinds of electronic valves, components, transistors, etc., and is busy at the moment in preparing itself to provide a similar efficient service to the Industry when Television arrives.

◈——◈

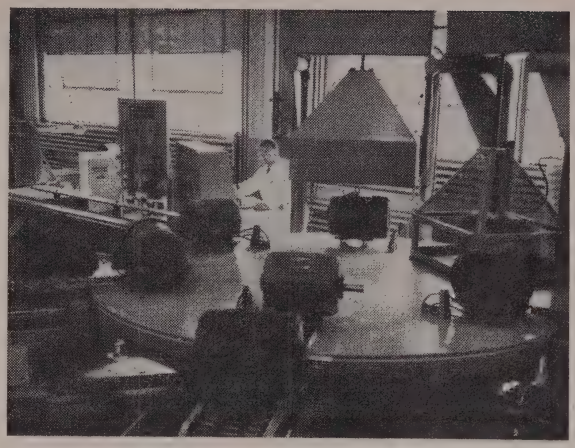
AUTOMATION INCREASES LABOUR FORCE IN U.S. MOTOR FACTORY

The automation of the new General Electric Company plant in Schenectady, New York, has not only reduced by 80 per cent the time required to manufacture certain types of electric induction motors, but has been accompanied by an increase in the labour force. Moreover, according to company officials a steady rise in employment is expected.

The new plant uses push-button controls to machine, assemble and test electric induction motors, which are widely used in industry.

It has been designed to meet an expanding market for motors, which it is estimated will grow about 75 per cent in the next ten years.

At present employing about 600 workers, the plant is a monument to mechanization, speed of assembly and uniformity of production. Machines, beginning with seven giant punch presses producing stator and rotor laminations and ending with crane lifts which remove the finished, boxed products for shipment, have largely replaced the human hand. With the exception of the section where motor windings are inserted, which remains basically a hand labour operation, the assembly line is almost fully automatic.



Finished motors receiving running, sound, and electrical characteristics tests automatically on rotating tables at the end of the production line.

Our cover picture shows a comparator which permits close inspection of tools and parts.

(Details supplied by U.S.I.S.)

BUSINESS FOR SALE

A sound, established radio, electrical, cycle, and sports business showing excellent returns, located in a progressive country district of the South Island, is being offered for sale.

Leading exclusive agencies include radio, all electrical appliances, and sporting equipment. Owner is retiring, and it is proposed to effect transfer as at 31st March, 1957. Any intending purchaser may, after investigation, make a firm agreement accordingly.

Price £6,000, with stock at valuation. Full particulars will be supplied to bona fide interested parties, and all inquiries will be treated with strictest confidence.

Apply to:

"OPPORTUNITY,"
C/o Radio & Electronics (N.Z.) Ltd.,
P.O. Box 8022, Wellington

TELEVISION IN AN AGE OF SCIENCE

By J. E. BENSON, B.Sc., M.E., M.I.E.E.

TELEVISION AND SOCIAL SCIENCE

Television is establishing itself throughout the civilized world today with amazing rapidity. Both in England and the U.S.A., considerably more than half the population is already within its range, and expansion is still in progress. England has now approximately one TV receiver for every 25 of its total population, while the U.S.A. has already exceeded a density of one for every six.

As a medium of mass communication, television has already established itself as second to none in human history. Its power over the minds of men is comparable in potential for good or evil only to that of atomic energy in the world of matter; and, as such, it presents a very great challenge to our social scientists, psychologists, philosophers, and theologians to show us how to use it wisely while we are still able. It is my sincere belief that its possibilities for good in the community far outweigh its potentialities for evil. But no good thing is ever achieved without effort. If we want television to serve the community, we must use it to communicate those ideas and ideals which go to build peoples and nations rather than those which destroy them. Television itself is neutral—it is **what we do with it** that is so important.

Television, itself a product of science, presents a challenge that is all the more urgent because of the impact of science in other departments of life. Our complex scientific civilization raises problems on the human level which call for better understanding and co-operation between individuals and groups of individuals. Television provides a means of "getting the story across," of communicating efficiently and pleasantly just those ideas and ideals to masses of people which make for better understanding, and hence better and safer living both for men and nations.

To the scientists, television is not only a medium of mass communication; it is fundamentally and essentially an electronic means of extending human vision almost without limit. As such, it has many valuable applications in education, scientific research, commerce, and industry quite apart from its popular use in broadcasting. In the remaining space at our disposal we shall consider some of the basic principles of television in monochrome and colour and indicate some application of special interest to us as scientists.

PRINCIPLES OF MONOCHROME TELEVISION

The heart of a television system is the photoelectric transducer or camera tube whose function is to transform an optical image into an electric signal. This may be done by one of the two basic phenomena of photoelectricity: (a) Photoelectric emission and (b) photo-conductivity. Though both have been known for more than 60 years, it is only within the last five years that the photo-conductive principle has found practical application in television. It is the basis of the recently developed miniature camera tube called the Vidicon, whose compactness makes it very popular for scientific and industrial applications where size is an important consideration.

In order to be able to transmit a picture over a single communication channel, it is necessary to convert the optical image, which is a spatial distribution of information, into a time sequence of electric current variations.

The process by which this is done is called scanning. In the early days of television, the picture was scanned by means of a rotary disc containing a spiral arrangement of holes. Today an electronic beam, deflected by magnetic fields conforming to a "saw tooth" time function, scans sequentially each element of the picture, point by point and line by line until the whole area is covered.

As the beam scans the picture, variations in brightness cause corresponding responding variations in the output current of the camera tube. These variations constitute the video or picture signal, which is then transmitted over a wire or radio channel in the same way as the electrical equivalent of a sound wave is transmitted over the telephone or radio.

A similar process occurs simultaneously at the receiver. An electron beam in the cathode-ray tube or kinescope which constitutes the viewing screen of the receiver scans the face of the tube in step with the beam of the camera. The intensity of the beam, and hence the brightness of the fluorescent phosphor on which it impinges, is controlled by the variations of the video signal, which is applied as an intensity modulation to the control grid of the kinescope.

The beams at both transmitter and receiver are held in step by means of a "synchronizing signal" comprising a series of accurately timed pulses occurring at the beginning of each "line" and "frame" period.

COLOUR TELEVISION

In order to transmit a colour picture by television, it is necessary to transmit, in addition to the brightness signal, further information corresponding to the hue and saturation or density of each dot of the picture being scanned.

As in colour photography and printing, a particular hue and saturation may be reproduced with sufficient accuracy for practical purposes by a correct proportion of three primary colours, the choice of which is determined, among other things, by the basic requirements that any one primary cannot be produced by a combination of the other two.

In the case of television, the process of colour mixing is the additive process by which quantities of light energy from three primary sources—viz., red, green, and blue, are superimposed to produce the desired colour. The precise hue and relative intensity of the primaries are so chosen that unit values of each, in combination, produce white.

The additive primaries, red, green, and blue, are the complementaries respectively, with reference to white, of the subtractive primaries cyan, yellow, and magenta, used in colour photography, printing, and dye mixing.

In the early days of colour television, it was thought to be necessary to send three complete and separate images, one in each of the additive primary colours, red, green, and blue. These were transmitted one after the other in rapid sequence and were seen by the eye as one composite colour picture. An alternative method was to transmit the three signals simultaneously and to combine the three images by optical means. Such a system required three times the frequency bandwidth of the monochrome system.

It was soon realized that, because the human eye is much less critical for detail discrimination in red and blue than it is in green, it would be possible to use lower definition in these colours without detracting from the picture quality. This resulted in a considerable saving in the bandwidth required to transmit the picture. After a vast amount of research extending over several years, the Radio Corporation of America developed a system in which the whole colour picture could be transmitted in the same bandwidth as that required for monochrome pictures. This system formed the basis of the one finally adopted by the National Television Systems Committee and approved by the Federal Communications Commission as the standard system for American colour television.

In the NTSC system, the colour information transmitted comprises two "signals" derived by subtractively combining two of the three primary component colour signals with the monochrome or brightness signals. These "colour difference" signals are transmitted as the amplitude-modulation sidebands of a pair of suppressed sub-carriers located within the pass band of the monochrome or brightness signal.

At the receiver, the "colour difference" signals are recovered and combined separately with the brightness signal to yield the three primary colour signals which in turn are fed as intensity-modulation signals to the colour picture tube.

An important feature of the NTSC system of colour television is that it is fully compatible with monochrome television. This means that a monochrome receiver will operate satisfactorily from the signal from a colour station and produce a picture in monochrome. The receiver merely ignores the colour-difference modulation and operates on the brightness signal, which is indistinguishable from the vision signal from a monochrome transmitter.

STEREO-TELEVISION

The stereoscopic effect can be produced in television just as it is done with films by arranging for separate images to be conveyed to each eye of the viewer. In present-day systems, two separate images are transmitted simultaneously and presented side by side on the receiver kinescope. The twin pictures are viewed either directly through a suitable prismatic viewer or by the aid of polaroid spectacles crossed with respect to polarizing filters covering the screen images.

Owing to the limitations imposed upon the viewers, it is improbable that stereoscopy will become universally popular for television any more than it has for motion pictures. Its application seems to be confined to special closed-circuit installations for scientific or industrial purposes or as a teaching aid, particularly in medicine.

TELEVISION—A SERVANT OF SCIENCE

We have seen how television—an infant prodigy from the womb of science, nurtured in an environment of technology, has now become a major social force in the world. After considering some of the principles underlying its manifestations in monochrome, colour, and stereoscopy, we turn to consider some of the ways in which television is serving as the handmaid of science itself.

With its capacity to extend human vision beyond the visible spectrum or under the sea, or through the microscope or telescope, it provides a tool for research of great value in many branches of fundamental science. By the same token, its potentialities in teaching and in applied science are now being appreciated on an ever-widening scale. As space does not permit of anything like a full treatment of these fields, it is hoped that the following notes will serve to indicate ways in which television is now serving science both in its quest for knowledge and in its service to mankind.

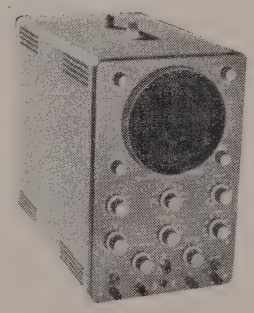
UNDER-WATER TELEVISION

This was first introduced in 1952 by the Marconi Company of England in association with the British Admiralty in the dramatic and successful search for the submarine "Affray," lost on the seabed of the English Channel. Since then under-water television has been developed and used extensively, not only by naval engineers but by marine biologists, for the study of the characteristics of marine life and oceanography. The advantages of television over direct photography are that observations can be spontaneous and continuous so that the scientist has direct and immediate control of his researches at all times unhampered by the delay and confusion inevitable when he has to rely on photographs and reports by a professional diver.

MICROBIOLOGY

The use of the television camera in conjunction with the microscope has a significant advantage over the conventional projection microscope for observation and class demonstration of live biological specimens. The amount of light required for television is so small compared with that required for direct projection that live specimens may be observed for long

(Concluded on page 48)



HEATHKIT

5" T.V.
BROADBAND
OSCILLOSCOPE
(IN KIT FORM)

This outstanding instrument provides all the facilities normally found only in instruments of more than twice the price.

Not a toy, but PRECISION instrument specially provided with all facilities required not only for TV servicing but also for all radio and amplifier work requiring a fine instrument at a reasonable price.

Easy-to-follow instructions. Printed circuits facilitate accurate wiring and better performance. Broadband amplifiers, push-pull, built-in sweep generator, and numerous other refinements. Styled in the HEATH tradition. Supplied complete with scale.

Price: £68 3s. Retail

You BUY Test Equipment, but you INVEST in a HEATHKIT

Ask for them by name . . . HEATHKIT

Trade inquiries to:

FRED ROTHSCHILD & SON

79-83 PRETORIA STREET, LOWER HUTT.

P.O. Box 170. :: Telephone: 61-698.

AROUND AND ABOUT

TRANSISTORIZED GOLF BALL

Though the electronic golf ball, developed by Motorola, has not yet appeared in sporting goods stores, golfers will hail its arrival eagerly. Lost balls may become a thing of the past with the development of a transistorized golf ball that transmits a sufficiently strong R.F. signal to be picked up by a portable pocket-size receiver. By merely rotating the receiver as a direction finder, a golfer can "home" on the elusive spheroid.

An experimental p-n-p type transistor is used in a simple Hartley oscillator circuit. The unit is powered by a small 3-volt battery. Of greater importance than this application is the fact that the extreme ruggedness of transistors is demonstrated.

◈——◈

AUTOMATIC ANNOUNCER

A novel automatic anouncing system which can reproduce, at the touch of a button, any one of 25 pre-recorded announcements, or signals, which can then be relayed over a loudspeaker system, has been developed by the General Electric Co. Ltd.

Messages are recorded side by side on a special loop of 3 in. magnetic tape, and the appropriate one selected by push-button when required. To make the system fully automatic, particular announcements such as shift changes, meal breaks or other messages can be triggered off by a master clock mechanism without the need for any human attendance. If required, the push-buttons can be mounted remotely from the instrument.

Originally, the automatic announcer was developed by the G.E.C. for British Railways (Eastern Region) and first installed at Stratford Station. In this installation, the platform announcements for passengers are automatically initiated by the trains themselves, first as they approach the station, and then again as they come to a standstill at the platform. Equipment of this type has now been adapted for general use and may be applied in any situation where numbers of routine broadcasts have to be repeated fairly frequently.

The paper-backed magnetic tape used is made in the form of a continuous loop 3⅛ in. wide, which normally lasts 30 seconds. Special loops can be supplied, however, having any duration between 10 seconds and about 4 minutes. A short length of metallic foil is spliced in at the point where the two ends of the loop join. At the end of the announcement the foil completes the circuit between two contact fingers, automatically switching off the mechanism and preparing it for the next announcement.

The loop of tape is moved past the playback head at a steady speed of 7½ in./sec. by a mechanical drive system powered by a 1/20 h.p. motor. The motor is dynamically balanced and resiliently mounted at the rear of the panel, the drive being transmitted by a flexible shaft, nylon helical gears and two large diameter pulleys coupled by a nylon-loaded fabric belt. On selecting the required announcement, either by push-button or by remote control, the play-back head is moved to the correct tracking position by a specially designed mechanism patented by the G.E.C. Control of the tape motor and the head positioning device is effected by a 25-position rotary selector switch associated with seven switching relays mounted under detachable covers.

◈——◈

NEW RADIO STATIONS FOR TRANS-POLAR AIR ROUTES

Marconi's have recently supplied transmitting equipment for three radio stations which are to be built in Greenland. One station is to be used for ground-to-air communications on the Trans-Atlantic and Trans-Polar air routes from Europe to North America, while the remaining two will serve the new Scandinavian Airlines System's Trans-Polar route from Scandinavia to Tokyo.

Six medium-power high-frequency channelized communications transmitters Type HC. 205 have been supplied, together with drive units, remote control and aerial matching equipments. Two Marconi engineers will be responsible for the installation work.

One station is to be installed at the present weather station Nord—the northern-most radio station in the world, less than 600 miles from the Pole. This station can only be reached by air, normally from the air base near Dundas, the second station, which is located on the North-West coast. The third station is Prins Christiansund, near the southern tip of Greenland. The sea route to Dundas, and thereby to Nord, is closed by ice for 10 months of the year and on this account it was necessary to send the equipment to Copenhagen by the beginning of July, in time to catch the last ship to call at Dundas this year.

Each station will have a dual installation of Type HC. 205 transmitters, one for operation, one for standby. A transmitter of this type is designed to radiate a number of simultaneous telegraph and telephone transmissions on separate crystal-controlled channels. One particularly interesting feature of the installations is that each transmitter will be operated by remote control, the changeover from main to standby also being effected by this means.

★ ★ ★

INFRA-RED IN THE FOODSTUFFS INDUSTRY

"Beschuiten" are a typical product of the Netherlands. They are fairly large, thick, round rusks, extremely light and crisp, which can be eaten at any time of the day in all manner of variations. It now appears that infra-red radiation can be used to good effect even in the production of "beschuiten".

By using 81 Philips infra-red drying lamps of 250 W each, it was possible in four days to increase production by 210,000 rusks, i.e., a trailer-full, while at the same time economizing by 25% on the original gas consumption. Owing to the favourable depth effect (penetration) of the short-wave infra-red radiation, the rusks are dried directly from the inside outwards, without the surface being scorched, as in other methods. The irradiation distance between the face of the bulb and the rusks arranged on the gauze sheet, amounts to about 12 cm.

The cost of the electrical energy required is amply offset by the saving on the gas bill.

★ ★ ★

HEATED SHOPS

Are shivering window-gazers likely to become buyers? The subject is worth studying, but nevertheless the management of the "Household & Commercial Services Co. Ltd." in Bridport, England, preferred a satisfactory solution of the problem. On the facade of the new showroom 23 Philips infra-red lamps have been installed in a large cover under a penthouse. In winter and on chilly evenings, these lamps serve to "pre-heat" interested customers. A grid under the lamps protects the passers-by from glare, thus preventing the well-lighted showrooms from losing their attraction. This service to old and new customers is given much attention and naturally is highly appreciated by the shopping public.

★ ★ ★

MONUMENT TO MOZART

Two hundred years ago the great composer Wolfgang Amadeus Mozart was born in the Austrian city of Salzburg. To commemorate this event Philips have produced 60 records of over 200 of Mozart's works. Conductors, orchestras, soloists and choirs of renown contributed to this series which bears the name of "Mozart Jubilee Edition, 1956". Supervision lay in the hands of the well-known conductor and President of the State Academy Mozarteum of Salzburg, Prof. dr. Bernhard Paumgartner.

★ ★ ★

TELEVISION IN THE FRENCH COUNTRYSIDE

During the early development of television in France a number of teachers realized the tremendous importance of this new medium of expression for the population of the countryside. To famliarize people with this new medium, and to facilitate the purchase of TV sets on a collective basis, they took the initiative in the foundation of "viewing clubs". Having organized these in two villages on the Ile de France in 1950, they soon succeeded in increasing this number to twenty, until gradually the whole of the agrarian countryside was co-operating.

This important work was recognized by UNESCO, and TV sets were installed on a large scale in all villages where TV-reception was possible. Life took on a new aspect in small hamlets in remote districts which hitherto offered only limited facilities of recreation and education. A new category of TV viewers was born, and the Radio Television Francaise had to allow for this in the composition of its programmes. Thus a

"R. and E."
DIGEST OF CIRCUITS
No. 3

PRICE 3s. 6d. (N.Z.)

NOW AVAILABLE

Order from your nearest bookseller or radio dealer, or from

Radio & Electronics (N. Z) Ltd.

P.O. Box 8022, Wellington

light up your living...

ENSIGN
LAMPS and TUBES

they're Britain's Best

Now available in New Zealand . . . longer life, combined with greater brilliance. Available in all sizes and types. Buy the best . . . buy ENSIGN.

Obtainable wherever lamps are sold

New Zealand Distributors:

P. C. BLENKARNE LTD. AUCKLAND, HAMILTON, PALMERSTON NORTH, WELLINGTON, CHRISTCHURCH, DUNEDIN.

series of transmissions was composed specially intended for farmers, contrasting the rational methods of today with the old-fashioned ways of farming. Viewers were shown every part of France, while the camera told the stories of districts such as the Landes, the Basses-Pyranees, Gers, Gard and Valois and Languedoc. Personal interviews with local farmers amplified the programme material. Thus, everyone became familiar with the working methods of others. Attention was paid to the contribution made by the State and the relationship between agriculture and industry.

Such programmes were enthusiastically received by both town and country viewers since they not only revealed the various agrarian problems but also depicted the fascinating beauty of hitherto unknown parts of the French countryside.

AUSTRALIANS FLY IN SAFETY

Latest important contribution to flying safely is Distance Measuring Equipment, an all-Australian invention now being installed throughout the Commonwealth. Principle of DME, which enables a pilot to tell his distance from beacons along the route simply by glancing at a dial, is that a radio signal emitted from the plane is automatically transmitted back by the appropriate ground station. Time elapsing between transmission and reception of the signal by the aircraft is electronically converted into distance in nautical miles.

Much of the initial credit for the successful development of DME is due to Dr. E. G. Bowen, Director of the Radio Physics Division of the Australian Commonwealth Scientific and Industrial Research Organization. Dr. Bowen, who made a major contribution to the evolution of radar during World War II, attended a postwar International Air Conference, and returned to Australia with this problem:

"Can we, from the mass of wartime radio aids that can navigate aircraft across hundreds of miles direct to a single factory target, release bombs when there, if necessary; and bring them home—devise for international flight a means of telling a single pilot, from a glance at a dial, his exact distance at any time from a known point, yet fully automatic in its operation and contained in a box no more than 40 lb. in weight?"

As a result of the close teamwork between CSIRO, the Commonwealth Aviation Department and research scientists of Amalgamated Wireless (Australasia) Limited, the problem has now been solved and Australia is the first country in the world to install this advanced flight aid on a national scale.

Already the entire national installation is nearing completion as A.W.A. puts the finishing touches to this complex but vital factor in Australia's fine record of air safety.

Television in an Age of Science

(Continued from page 46)

periods without danger of destroying them by the heat of the projection lamp.

ULTRA-VIOLET MICROSCOPY

The sensitivity of the television camera to ultra-violet light makes possible a direct optical observation of specimens under ultra-violet illumination. The television equipment serves thus as a frequency converter from the ultra-violet to the visible region, whilst retaining the advantages of the detail discrimination characteristics of the ultra-violet image only previously obtainable by the indirect medium of photography.

An interesting extension of this technique has been developed by Dr V. K. Zworykin, of the Radio Corporation of America, using a colour television system in association with an illumination source comprising three separate frequency bands of ultra-violet light. The resulting colour picture provides a visual representation of the particular tonal rendition of the specimen under trichromatic ultra-violet radiation.

TEACHING OF SURGERY

Television is now well established as a visual aid in the post-graduate teaching of surgical techniques and for demonstration to medical conferences. Television provides the element of immediacy and spontaneity for an unlimited number of observers not possible by any other means. It is to be regarded as complementary rather than as an alternative to the use of film for teaching purposes.

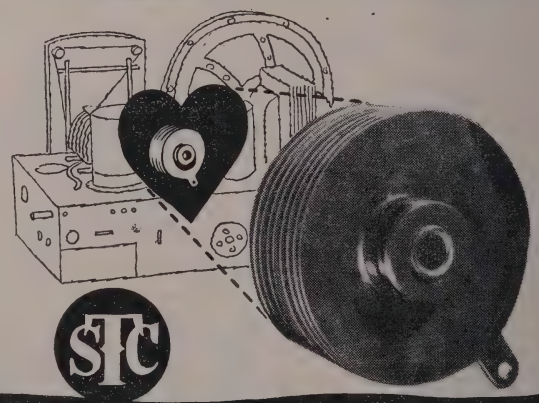
This is a field in which the ultimate techniques of television, both in colour and stereoscopic relief, can be most valuably employed in the highest service to mankind.

EICOnomise - Buy EICO INSTRUMENT KITSETS

"R & E" TECHNICAL PHOTOGRAPHS

Copies of original designs produced in our laboratory and featured in these pages are available. Prices are: Size 6 in. x 4 in. 3s. 6d.; 8 x 6, 4s. 6d.; 10 x 8, 5s. 6d. Please remit cash with order to Radio and Electronics (N.Z.) Ltd., P.O. Box 8022, Wellington.

The HEART of the Portable



STC

MINIATURE RADIO RECTIFIER

★ Precision-built
★ Peak performance
★ Practically unbreakable

Servicing Portables? Replace with STC Miniature Radio Rectifiers. The world's standard - first choice among progressive servicemen.

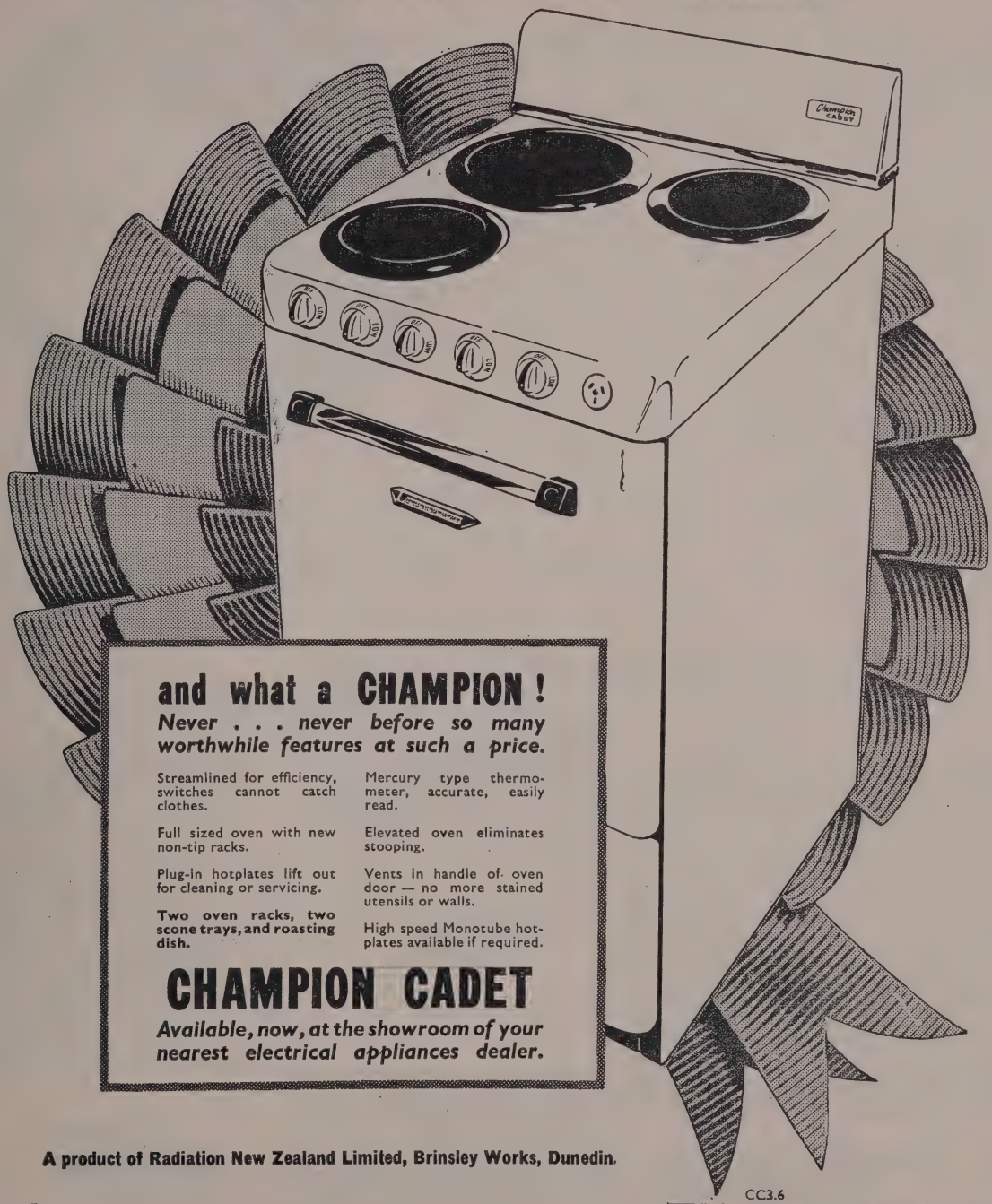
Write, phone, or call the Sole New Zealand Agents:

STANDARD TELEPHONES & CABLES PTY. LTD

WELLINGTON Box 593 AUCKLAND Box 571
CHRISTCHURCH Box 983 WANGANUI Box 293

There's a **new** Champion in the low priced field!

THE CHAMPION CADET



and what a CHAMPION!

Never . . . never before so many worthwhile features at such a price.

Streamlined for efficiency, switches cannot catch clothes.

Full sized oven with new non-tip racks.

Plug-in hotplates lift out for cleaning or servicing.

Two oven racks, two scone trays, and roasting dish.

Mercury type thermometer, accurate, easily read.

Elevated oven eliminates stooping.

Vents in handle of oven door — no more stained utensils or walls.

High speed Monotube hotplates available if required.

CHAMPION CADET

Available, now, at the showroom of your nearest electrical appliances dealer.

A product of Radiation New Zealand Limited, Brinsley Works, Dunedin.

CC3.6

To help YOUR SALES

Heavy space bookings for the above advertisement have been made in all the most important National Magazines, and Metropolitan and Provincial Dailies.

LIBERAL FRANCHISE TO STOCKISTS

Cash in on the tremendous demand for this sensational fast-selling Cooker.

Get in touch with the manufacturers, RADIATION N.Z. LTD., Brinsley Works, P.O. Box 522, Dunedin.

TV in the Service of Science

(Continued from page 22)

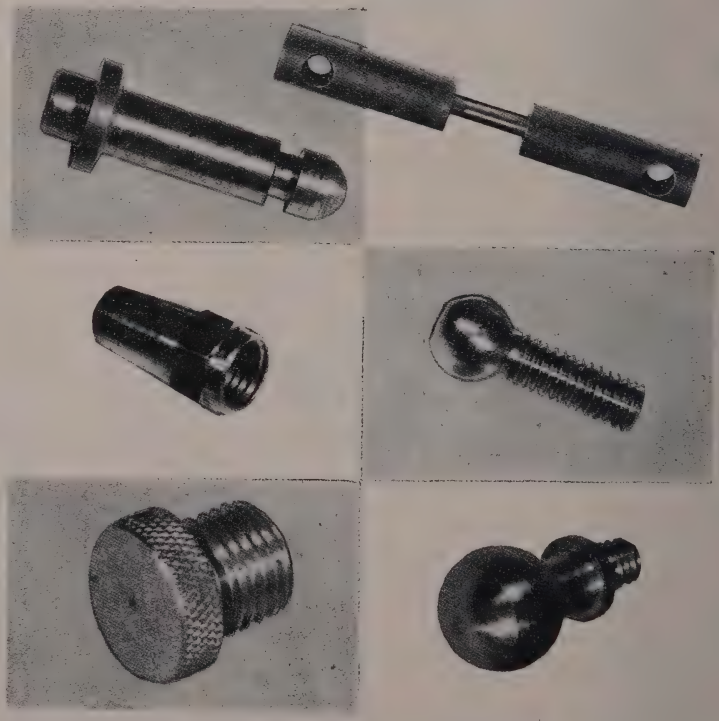
A further application of television camera tubes is in the detection of faint optical images—for example, as are encountered in astronomy and astrophysics. The main difficulties associated with existing optical telescopes are the long exposures required to record a satisfactory image of the distant stars, together with the general fogging due to sky glow.

The greater quantum efficiency of the photo-electric effect, which can reach 20 per cent., would help considerably in astronomy. In addition, it is known that the reciprocity law holds down to very low light levels; a wide range of wavelengths can be covered; electronic presentation is possible; the signal-to-noise ratio is improved; and that the sky background can be removed electronically. All these factors of the photo-electric effect could be useful in extending the range of the existing 200 in. Hale telescope such that it would be possible to record stars whose brightnesses are three magnitudes smaller than those observed at present. This would mean that light would be observed from stars which had taken 5,000,000,000 years to reach the earth, and this time duration is believed to correspond approximately to the age of our universe.

PHILIPS for Light

Here's proof of versatility

Six component parts all made from bar stock up to 2¼ inches in diamter—all different, and yet all similar. Different because each unit is made to the specifications of an individual manufacturer like yourself—similar because they are all mass produced to the same exacting standard of uniformity at the rate of several per minute, and at lowest possible cost. This is the service *you* may expect from



Auto Machine Manufacturing Co. Ltd.

18–20 NELSON STREET, AUCKLAND
P.O. BOX 179 - - AUCKLAND

Hi-Fi Sales

(Continued from page 37)

In selecting the record or records to be used in a demonstration, you can follow one of two theories. Many dealers feel it is important to maintain a supply of records to fit any customer's tastes: jazz, symphonic, opera, piano, etc. (It is estimated that 90 per cent. of high-fidelity customers are interested in classical music.) Dealers who maintain a wide collection of records believe the best way to appeal to a serious prospect is to play the kind of music dearest to his heart.

On the other hand, many American retailers use specially recorded discs designed to test high-fidelity equipment. The music of these records is selected not for its musical value, but for the wide range of sounds it covers. Proponents of this method of demonstration say that if you play a favourite symphony for a prospect, he gets so carried away by the music that he forgets the sale—but that a test record keeps his mind on the equipment.

High-fidelity equipment should be sold in much the same way that glasses are fitted. Neither sight nor sound perception of any two persons is exactly alike. Any set of audio components must, therefore, be "fitted" to suit the individual's preferences—and also to suit his pocketbook.

N.Z.E.I. Notes

(Continued from page 30)

Zealand, Mr. Foster discussed the syllabus, emphasising that the examination was based on fundamental principles so that a serviceman, with the aid of the manufacturer's circuit diagram, could understand the functioning of any receiver.

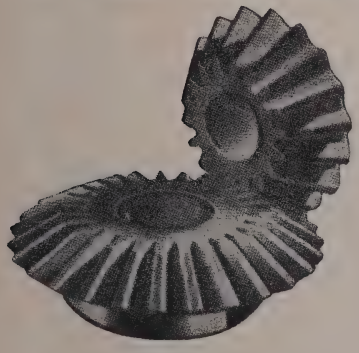
Tape Recorder Used:

For the benefit of country members, the meeting was recorded on tape.

Building of Amplifier and Pick-up for Reproduction of Historic Maori Recordings

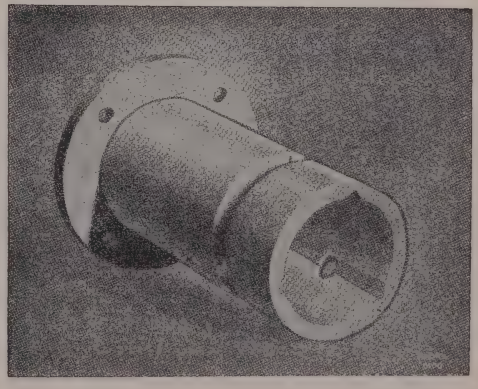
Before closing the meeting, the chairman announced the inauguration of an important branch project, namely the building for the Maori Affairs Department of an amplifier and pick-up for the play-back and recording of phonograph cylinders. Until now, lacking the necessary electronic play-back equipment, recordings made by the late Sir Apirana Ngata on an Edison phonograph have been of no use. These recordings of Maori chants are of much historical interest and will make a valuable contribution to the work of students of this subject.

TUFNOL



Bearings and Gears

TUFNOL Bearings and Gears have a wide range of uses from light duty in scientific instruments to heavy duty in steel rolling mills. They will often give excellent service in situations where bearings of other materials are unsatisfactory.



TUFNOL Bearings do not score shafts, they save power and reduce lubrication costs. Raw material in sheet, tube and rod form is available ex stock Christchurch.

Sole Dominion Agents—

B. R. HOMERSHAM LTD.

Electrical and Mechanical Engineers. 126 Victoria Street, Christchurch. P.O. Box 280.

Auckland Agent: W. & K. McLean Ltd., P.O. Box 48, Auckland.

Wellington Branch: B. R. Homersham Ltd., P.O. Box 572, Wellington.

Brilliant New MONARCH

FOUR - SPEED AUTOCHANGER!

78-45-33-and now 16 r.p.m.

For the first time since the invention of the gramophone, one instrument can play 78, 45, 33, and the sensational new 16 r.p.m. extra-long-play records.

Note these star points:

- ★ Plays ten 12 in., 10 in., or 7 in. records at 78, 45, or 33 r.p.m.—and the new 16 r.p.m. records.
- ★ Intermixes ten 7 in., 10 in, and 12 in. records of the same speed.
- ★ Manual play position for playing single records.
- ★ High-fidelity crystal pick-up with dual sapphire styli.
- ★ Exquisitely styled — choice of two beautiful polychromatic finishes.

MANUFACTURED BY BIRMINGHAM SOUND REPRODUCERS LTD., ENGLAND

BSR

Monarch

Four-Speed Autochanger **model UA8**

Sole New Zealand Representative:

DAVID J. REID (N.Z.) LTD.

P.O. BOX 2630, 271 VICTORIA STREET WEST, AUCKLAND. PHONE 30-832 & 78-247.

NEECO RADIANT HEAT ELECTRIC RANGES

The name they know... The product they can trust

Consistent advertising, dependable products and fair dealing have established Neeco as New Zealand's leading manufacturers of electric ranges. With a Neeco you're half way to a sale before you start!

THE NATIONAL NEECO ELECTRICAL AND ENGINEERING COMPANY LIMITED

AUCKLAND – WELLINGTON – CHRISTCHURCH – DUNEDIN
HAMILTON – NEW PLYMOUTH – WANGANUI – HASTINGS
INVERCARGILL

Consort

Low price, advanced features.

Sovereign

Medium price range, popular choice.

Ensemble

"Eye-level" cooking, fully automatic.

N8.6

Now available in New Zealand

EKCO LAMPS and TUBES

BRITAIN'S FINEST

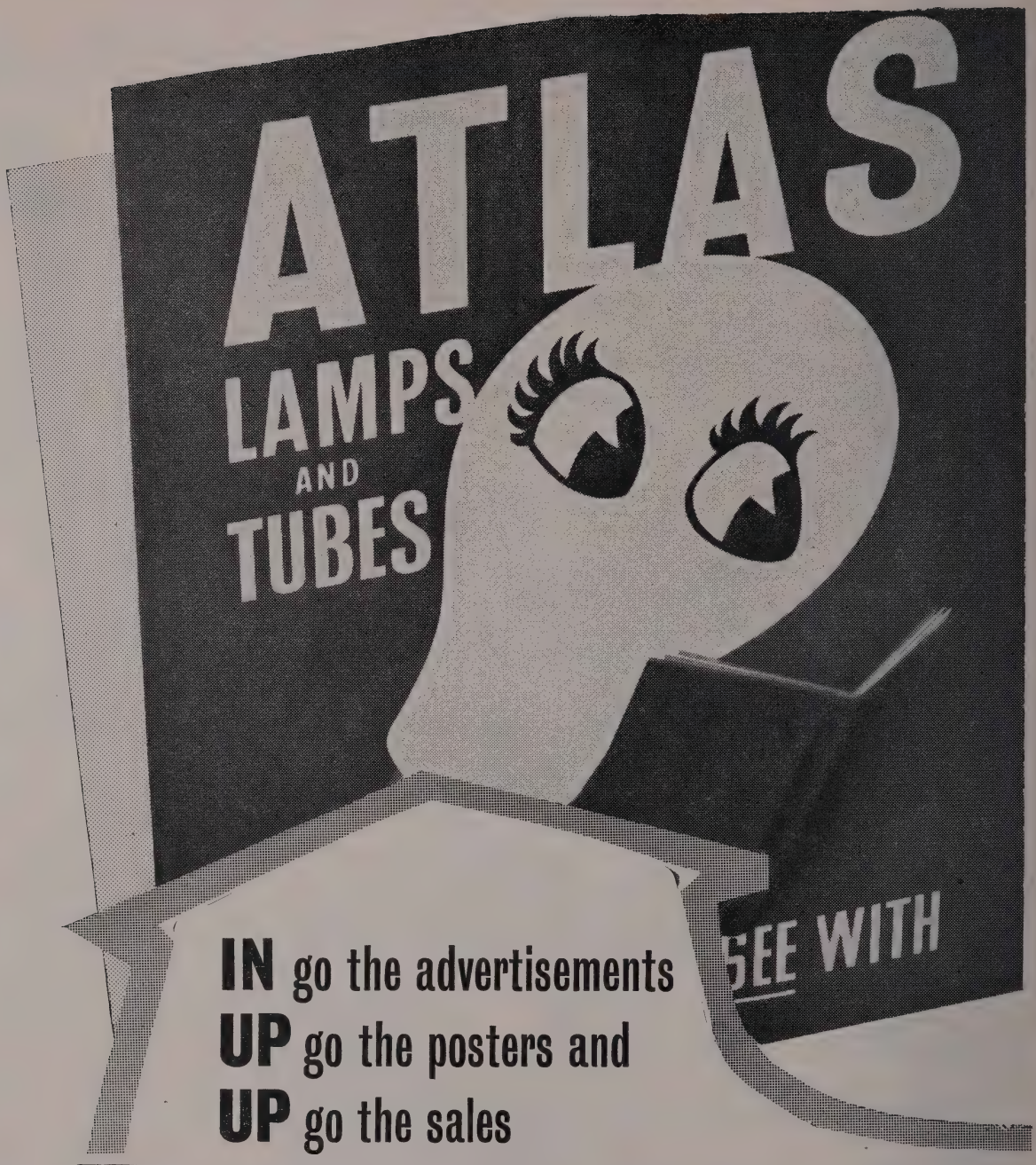
they're better to see with

The complete range and types of EKCO Lamps, Fittings, and Control Gear, conform with the current British standards, and to the highest standards of efficiency and manufacture. . . . The perfect product of top British engineering.

NEW ZEALAND DISTRIBUTORS:

JOSEPH NATHAN & CO. (N.Z.) LTD.

AUCKLAND : WELLINGTON : CHRISTCHURCH



IN go the advertisements
UP go the posters and
UP go the sales

Thorn

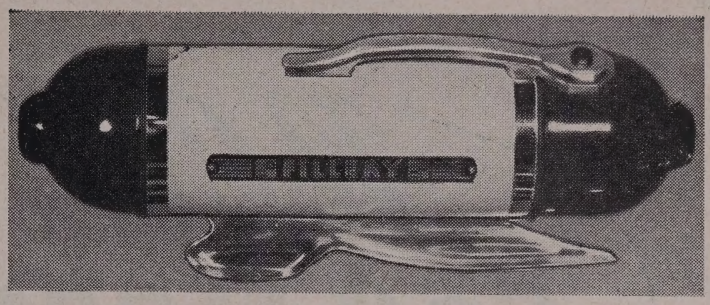
DISPLAY ATLAS LAMPS
PROMINENTLY IN YOUR *WINDOW*
AND TIE UP WITH THIS PUBLICITY DRIVE

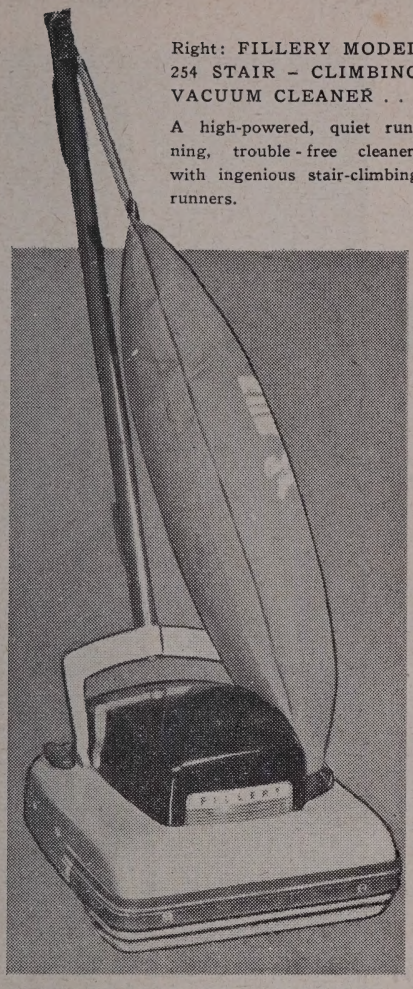
New Zealand Distributors:

K. SIMPSON LTD., P.O. Box 2498, Auckland
ARNOLD & WRIGHT LTD P.O. Box 2253, Auckland
and P.O. Box 6198, Wellington
EGLEY ELECTRICAL CO. P.O. Box 765, Wellington
ZONTILIER FLUORESCENT LIGHTING CO. LTD.
P.O. Box 5030, Wellington
THOMAS HYDE LTD. P.O. Box 503, Christchurch

Right: FILLERY MODEL 254 STAIR – CLIMBING VACUUM CLEANER . . .

A high-powered, quiet running, trouble-free cleaner, with ingenious stair-climbing runners.





Clean up!

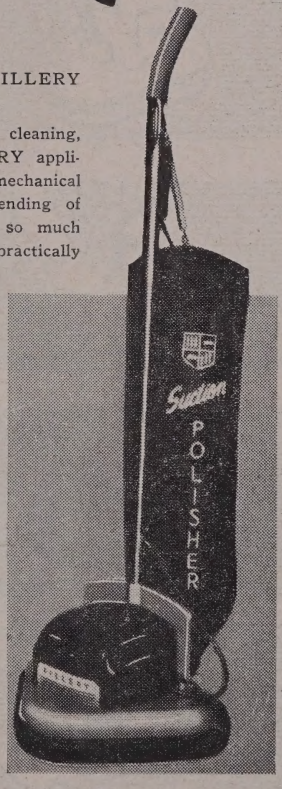
WITH THESE 4 GREAT FILLERY MONEY-SPINNERS . . .

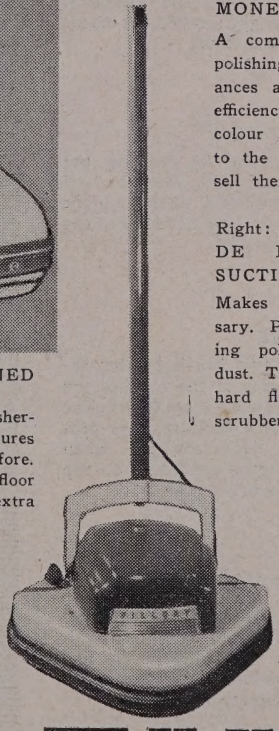
A complete range for vacuum cleaning, polishing and scrubbing. FILLERY appliances are engineered for high mechanical efficiency combined with that blending of colour and design which means so much to the modern housewife. They practically sell themselves.

Above: FILLERY V.P.I. COMBINED CLEANER-POLISHER . . .
The world's only Vacuum Cleaner-Polisher-Scrubber with a host of unique features for easier cleaning than ever before. FILLERY Attachments for above-floor cleaning and scrubbing optional at extra cost.

Right: FILLERY SP3 DE LUXE 3-BRUSH SUCTION POLISHER

Makes pre-sweeping unnecessary. Powerful suction during polishing whisks away dust. The perfect cleaner for hard floor surfaces. It's a scrubber as well!





Left: FILLERY P3 STANDARD 3-BRUSH POLISHER—

A sturdy, attractive machine developing ample power for every polishing job.

Serial No ★ 2240
BRITISH
GOOD HOUSEKEEPING INSTITUTE
GUARANTEES
REFUND OF MONEY OR REPLACEMENT IF NOT IN CONFORMITY WITH THE INSTITUTE'S STANDARDS

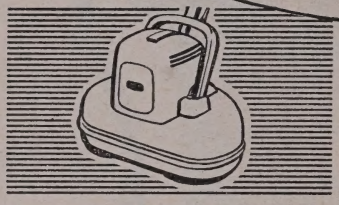
Write now for full details of these fast-selling FILLERY Cleaners to the N.Z. Distributors:

H. W. CLARKE (N.Z.) LIMITED
AUCKLAND, WELLINGTON,
CHRISTCHURCH, DUNEDIN.

FILLERY

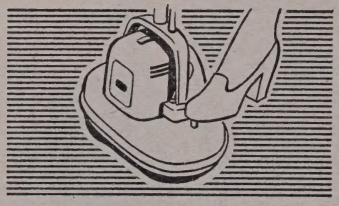
new

G.E.C. FLOOR POLISHER



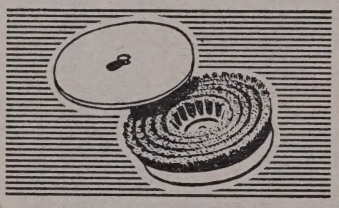
★ *Automatic switching*

As the handle is lowered to the working position shown, the switch is operated and the motor starts. When the handle is returned to the upright position the motor is automatically switched off.



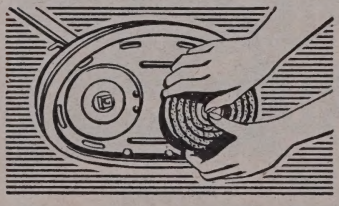
★ *Handle release*

The handle is released by pressing the handle-release button with your toe and lowering. When returned to the upright position it is automatically locked until the button is again depressed.



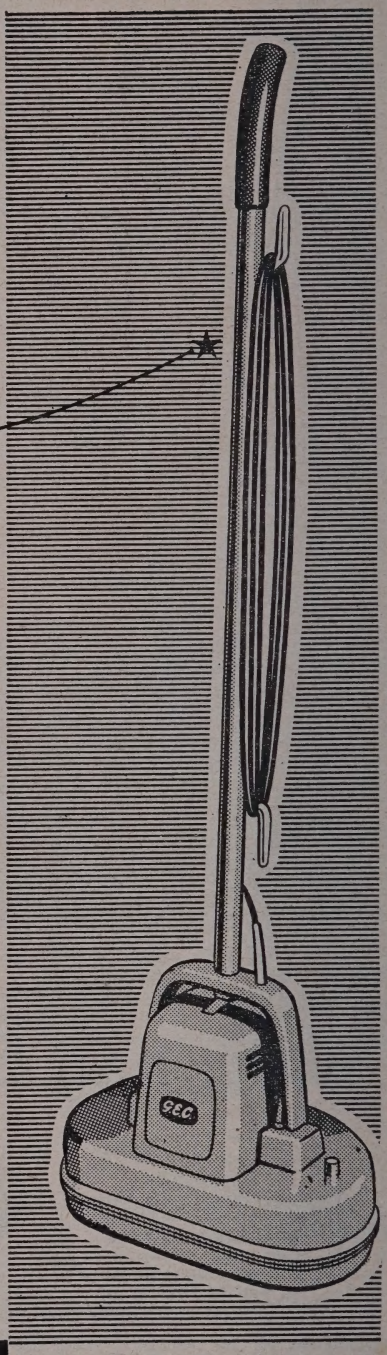
★ *Accessories*

Two felt pads and two bristle brushes are supplied. The bristles of the brushes are specially angled to enable them to get close to walls, corners and furniture, thus providing maximum floor coverage when polishing. The felt pads are placed on top of the brushes for a brilliant finish.



★ *Easy removal*

The two rotating brushes are easily removed for cleaning and replaced by simply holding as illustrated. For exceptionally fine polishing work Lambswool buffs are available as an optional extra.



G.E.C.

BRITISH GENERAL ELECTRIC CO. LTD.

NEW ZEALAND SUBSIDIARY OF THE GENERAL ELECTRIC CO. LTD. OF ENGLAND.

Wellington, Auckland, Hamilton, Napier, Christchurch, Dunedin, Invercargill.

PRICE £20·0·0

Now available in N.Z.!

TELEFUNKEN TUBES

LEADERS IN EUROPE FOR 50 YEARS

Made by the most famous of all German Electronic equipment manufacturers, Telefunken Tubes are impressive examples of German technical skill and efficiency developed over half a century! It is literally impossible to buy tubes of higher quality—yet they cost no more than ordinary run-of-the-mill tubes.

In stock now and ready for distribution throughout New Zealand.

Also available from A.W.A. and NEECO —immense stocks of A.W.V. Radiotron and R.C.A. tubes covering a complete range of American series makes.

Complete range of Continental types available for immediate delivery:—

AZ41	EL41
DK40	EL84
EAF42	UAF42
ECH42	UBC41
EBC41	UCH42
ECH81	UL41
EF41	UY41

etc., etc.

AND at regular prices.

ADDRESS YOUR INQUIRIES RIGHT AWAY TO THE NEW ZEALAND DISTRIBUTORS:

AMALGAMATED WIRELESS (Australasia) LIMITED

P.O. BOX 830, WELLINGTON. P.O. BOX 1363, AUCKLAND
P.O. BOX 2084, CHRISTCHURCH.

AND AVAILABLE FROM: NATIONAL ELECTRICAL & ENGINEERING CO. LIMITED
(ALL BRANCHES)

Goodmans

AXIOM *Loudspeakers*

SOUND REPRODUCTION FOR HIGH FIDELITY

OTHER MODELS INCLUDE:

AXIOM 80 (6 watts)

The extended frequency coverage from 20/20,000 c.p.s. in free air has been achieved by the patented Duplex Cantilever (free suspension) cone assembly.
Brief Specification:

Frequency Coverage ..... 20/20,000 c.p.s.
Fundamental Resonance ..... 20 c.p.s.
Flux Density ..... 17,000 gauss
Net Weight ..... 9 lb. 6 oz. (4.2 Kgs.)
Impedance ..... 15 ohms

AXIETTE (5 watts)

A single-cone unit with an extremely well-balanced frequency coverage — ideal for small rooms.

Brief Specification:

Frequency Coverage ..... 40/15,000 c.p.s.
Fundamental Resonance ..... 65 c.p.s.
Flux Density ..... 13,500 gauss
Net Weight ..... 3 lb. 4 oz. (1.47 Kgs.)
Impedance ..... 3 or 15 ohms

ILLUSTRATED:

AXIOM 150 MK II 12 in.

A full range High Fidelity reproducer with a power handling capacity of 15 watts.

Brief Specification:

Frequency Coverage ..... 30/15,000 c.p.s.
Fundamental Resonance ..... 35 c.p.s.
Flux Density ..... 14,000 gauss
Net Weight ..... 12 lb. 13 oz. (5.8 Kgs.)
Impedance ..... 15 ohms

AUDIOM 60 12 in.

A versatile single-cone 15 watts loud-speaker, available with bass resonance of 35, 55 or 75 c.p.s. The two former are particularly suited for High Fidelity Crossover Systems with AXIETTE as Treble unit.

Brief Specification:

Flux Density ..... 14,000 gauss
Total Flux ..... 158,000 maxwells
Net Weight ..... 12 lb. 13 oz. (5.8 Kgs.)
Impedance ..... 15 ohms

FULL DETAILS OF ALL MODELS FROM SOLE NEW ZEALAND AGENTS:

TURNBULL & JONES LTD.

AUCKLAND - HAMILTON - PALMERSTON NORTH - WELLINGTON
NELSON - CHRISTCHURCH - DUNEDIN - INVERCARGILL